2019

The use of the Personal Response System (PRS) at King Khalid University for learning development

Alzahrani, Bandar

Copyright Statement

UNIVERSITY OF
PLYMOUTH

The use of the Personal Response System (PRS) at King Khalid University for learning development

By

Bandar Alzahrani

A thesis submitted to the University of Plymouth in

partial fulfilment for the degree of

DOCTOR OF PHILOSOPHY

Faculty of Arts and Humanities

November 2019

Acknowledgement

Firstly, I would like to thank my God who provided me with health, ability and patience to conduct this research. I am grateful to The University of Plymouth represented in its administration and staff for providing an ideal environment for learning and research.

Secondly, I am indebted and grateful to my first supervisor, Dr Peter Kelly for his support, guidance, encouragement and being more than a friend during my PhD journey. Thank you very much Peter from the bottom of my heart for everything. I have learned a lot of things from you not only about educational research, but about life itself. Whenever I needed you, you were there to support. Many thanks to my second supervisor Dr Steve Wheeler who was very keen to join all our meetings. I would like to thank him very much for his support and guidance. We really constituted a good triangular work team.

Thirdly, I am grateful to many great individuals for their support and advice throughout the development of this thesis. I especially thank Professor Victor Lilly, Professor Quintin Cutts, Professor John Traxler, Dr Phil Davice, Professor Steve Fleetwood , Dr. Abdullah Almaghzom and so many other researchers. I also believe I owe an apology to anyone who supported and encouraged me in completing my PhD thesis but whom I have forgotten to acknowledge here.

Last, but by no means least, I owe my sincere and earnest appreciation to my entire family, parents, sisters, brothers, uncles, aunties and cousins for encouraging me to finish my studies, their prayers, patience and continuous financial and moral support throughout my entire life.

Author's declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Doctoral College Quality Sub-Committee. Work submitted for this research degree at the University of Plymouth has not formed part of any other degree either at the University of Plymouth or at another establishment. This study was financed with the aid of a studentship form the Saudi Cultural Bureau in London.

Presentations at conferences:

- Combining Activity Theory and Grounded Theory to understand the use of Technology in Higher education. ICEEPSY (the International Conference on Education and Educational Psychology) - October 2015 – Istanbul- Turkey.
- Analysing the use of the Personal Responses System (PRS) through activity theory lenses. INTED (10th Annual International Technology, Education and Development Conference)2016 – March 2016 – Valencia- Spain.
- The use of the Personal Response System for Learning Development-IHC and EdD Postgraduate Research Student Conference – April 2015- Plymouth University – UK.
- Postgraduate Research Conference - IHC and Institute of Education – June 2015- Plymouth University – UK.
- Social Sciences Post Graduate Conference- June 2015- Plymouth University- UK.
- Technology & Pedagogy in Practice Conference – October 2015 – organized by Digital ELT- Ireland.
- Cumberland Lodge Conference – August 2015 – London- UK.

Word count of main body of thesis: 78588 words
Signed Bandar Alzahrani
Date 04 Nov 2019

Abstract

This study will evaluate the use of the Personal Response System (PRS) to increase interactivity in the classroom and change the form of learning from transmissive to constructive learning in Saudi Higher Education. PRS is a technology to enable students in the educational environment to answer questions individually or group and anonymously to the lecturer's questions. In this study, Activity Theory (AT) has been applied to explore how PRS has changed learning and increases interactivity. The constructionist paradigm has been adopted to create a deep understanding of the use of PRS. The case study methodology was employed in this study. This study has been conducted in Saudi Arabia at King Khalid University (KKU). Grounded Theory (GT) informed the methods of collecting and analysing data. The combination of AT and Grounded Theory was a successful approach, providing a deeper understanding of the use of PRS for learning development. Three methods were used: interviews with lecturers, and group interviews and questionnaires with students. The sample population was chosen from KKU and that included male lecturers and students. Due to cultural limitations, the researcher was unable to gather data from female lecturers or students. In Saudi Education there is segregation between both genders in all levels of learning. The number of participants in this study was 9 lecturers and 76 students from the medical school at King Khalid University. The students are doing bachelor's degrees in medicine and nursing.

The findings of this study show introducing PRS has increased interaction inside the classroom. The students reported they are more able to engage with learning and the lecturers are more able to ask questions and assess students' understanding of the content. Additionally, the role for the students has changed from passive learners to more active learners, who can answer questions, ask questions of their lecturers and discuss the answers with other students. Using AT has revealed many changes in the relationships between students and relationships between students and lecturers. The roles for the individuals participating in learning activities and the rules of the learning activities have changed, allowing time for questions to be asked of all students and the lecturer can offer faster feedback. Shier and less confident students are more able to engage in learning activities with PRS. This enables students to gain a deeper understanding of their subject and course material. Deep understanding is here defined as understanding the meaning of the concepts of the subject as the content is delivered in English. Further, some students defined deep understanding as understanding the concepts in each lecture and connecting these concepts.

Using AT analysis and GT as an approach to collecting data has shown several implications for using PRS for learning development. The study concluded that PRS is an effective technology to increase learner interactivity and change the format of traditional lectures. However, there is a need for more training for lecturers to use PRS effectively. PRS can be used with different learning styles, for example, individually or within groups. Therefore, for future research, applying collaborative learning might be a successful approach to investigate the use of PRS.

Dedication

To my lovely Children (Eliana and Turki) and my wife

To my family (specially my father, my mother, my brothers and sisters)

To my supervisors Dr. Peter Kelly and Dr. Steve wheeler

To the research community at the University of Plymouth

Contents

The list of Tables

The Figures

Table of Glossary

Abbreviation	Meaning
PRS	Personal Responses System
AT	Activity Theory
GT	Grounded Theory
KKU	King Khalid University
HEIs	Higher Education Institutions
KSA	Kingdom of Saudi Arabia
ATM	Technology Acceptance Model
ET	Education Technology
ZPD	Zone of Proximal Development

Chapter 1: Introduction

1. Introduction

In recent years, we have witnessed many changes in our lives as technology has developed and advanced. This revolution in technology has influenced the small details of our lives (Lee, 2002), including the field of education, where the introduction of new technology is producing significant changes. Accordingly, methods of teaching and learning has changed to engage the use of new technology. The aims for the educational systems are to develop individuals' skills and spreading knowledge in the society (Alzaydi, 2010). Moreover, Educational Technology (ET) is becoming an essential part of education nowadays and many students and educators will expect educational institutes to embrace technology (Geer & Sweeney, 2012). Therefore, many countries are investing a vast amount of money and effort to develop the education system at all stages and levels. Great efforts and a part of the budget go towards introducing new Educational Technologies to education. ET is defined as a set of tools to help students to develop their skills and improve their learning, and to enhance teaching methods for educators (Caldwell, 2007).

Therefore, many countries are working to change the format of traditional classes to more interactive classes using technologies. The use of new technology will help to improve the learning and teaching experience for students and educators (Alrouqi, 2015). For example, in the UK, the government spent £500 million to integrate technology in public schools (Holmes & Gardner, 2006). In Saudi Arabia making changes to learning from traditional learning to more student-centred learning through implementing new technology in education is a remarkable endeavour (Algahtani, 2011). A great deal of the budget has been spent to integrate technology and to offer program training. One of the technologies widely introduced across the world is the Personal Responses System (PRS)

(Meed& Fisher, 2009). PRS is a technology to enable students in the educational environment to answer questions individually or group and anonymously to the lecturer's questions (Levy, Yardley et al. 2017). PRS has been widely used in many countries, for example, in the UK, USA, Canada, Australia and countries throughout Africa and Asia PRS has been adopted in Higher Education institutes as a new technology to enhance "the social context of learning" (Meedzan & Fisher, 2009). The traditional format of lectures is transmissive, wherein a lecturer delivers information and students act as receivers (Alrouqi, 2015). Additionally, many educators see traditional lectures are boring and students do not feel motivated to learn in them (Meedzan & Fisher, 2009). Teacher-centred methods for learning can be ineffective, since students do not engage in the learning (Duruji *et al.*, 2015). Therefore, PRS is a solution for educators to change the pattern of learning from transmissive to constructivist learning as it allows students to engage with their own learning and to construct their learning around more interaction. PRS has helped students to be active during the learning process by allowing teachers to ask questions and students answer the questions. However, the use of PRS is still at the early stages in Saudi Arabia and was introduced in only two universities (King Khalid University, in 2011, and King Saud University, in 2014). In the early stages some difficulties may be encountered in the successful implementation of this technology in HEIs. During this study, the use of PRS at King Khalid University will be evaluated from male students' perceptions, examining the strengths, weaknesses, problems and difficulties faced during the use of this approach.

The following section will focus on the context of the study in Saudi Arabia. It will cover location, culture, education, the economy and the introduction of the new technology. All these factors play important roles in terms of the perception of the new technology and how effective it is for learning.

2. The context of study

Improving and introducing technology is influenced by the context in which it is being studied. Therefore, the use of technology must be understood and analysed in the context where is being used. This study has taken place in the context of Saudi Arabia. In order to understand the study context, detailed information about Saudi Arabia must be discussed, with a focus on keys points related to this research.

A. Education philosophy in Saudi Arabia

The educational philosophy in Saudi is based mainly on the principles of the Islamic religion and teaching these principles to the younger generations. There is an emphasis on teaching the right Islamic principles. Additionally, education providers need to promote tolerance, co-existence, and the development of knowledge and skills for the benefit of society. The educational policy in the Kingdom of Saudi Arabia (KSA) is committed to instilling Islamic beliefs and spreading them to the younger generation, understanding Islamic principles in the correct manner, with a strong religious base, providing them with values and virtues, and providing them with appropriate knowledge and skills.

B. The structure of the education system in Saudi Arabia

Members of Saudi society receive education at different ages and in different stages, including pre-school, primary school, intermediate school, secondary school and Higher Education.

i. Pre-school (Nursery school)

At this stage, students are accepted aged from 3 to 5 years, however entry at this stage is not compulsory. This stage is considered as extension of the home for children, therefore the aim is to take care of them and provide them with an opportunity to play and learn basic letters and numbers.

3. Primary school

This stage accepts students between the ages of 6 to 12 years and lasts for six years. The move from each level to the next is based on passing a specific criteria for continuous assessment for main skills, such as writing, reading and so on. In this stage, the aims are enabling students to read, write and learn arithmetic. At the end of this stage students are granted certificates which allow them to progress to the next stage (intermediate school). At this stage, boys and girls begin to study separately and education becomes compulsory.

i. Intermediate School

This stage comes after primary school and takes three years, inducting students from 12 to 15 years old. At this stage, the students grasp essential subjects such as Arabic, Islamic studies, social studies and science. Therefore, at this stage students acquire the required knowledge and skills to develop further, which is the most important aim for the education provider at this stage. At this stage the students also start to learn English as a foreign language.

ii. Secondary School

This stage spans three years, from the age of 15 to 18 years, and includes different subjects than the previous stages. The students learn more narrow knowledge and skills. For example, they start to study computing. Therefore, the aim at this stage is to prepare students for the real world by developing their vocational skills for work and the next stage. Completing this stage is a basic requirement to enter university, although not all students do; some join technical institutions and some choose the labour market instead.

iii. Higher Education

Students enter this stage after completing the secondary stage, from age 18 or older. The duration of undergraduate courses varies according to specialization. Some courses, such as Education and Science, span for 4 years, others, like Engineering and Pharmacy are 5 year courses, and Medicine lasts for 7 years. Many Saudi universities also provide postgraduate courses (High Diploma, Masters or PhD).

Previously, these stages were managed by two different agencies, the Ministry of Learning and Education and the Ministry of Higher Education. Now all these stages are under the supervision of one agency, the Ministry of Education.

C. The challenges in HEIs in Saudi Arabia

Regardless of the effort and budget spent to achieve the objectives of the learning process in Higher Education there are many challenges. One major challenge is the lack of motivation for students to engage in the learning process (Alamri, 2011). For example, the way students are asked questions embarrasses the students, especially if they don't know the answer, and usually the question is in English, which is not their native language. Therefore the students do not feel motivated to engage in this type of activity. In addition, lecturers are not motivated to engage with teaching, especially with large numbers of students in their classes (Alebaikan & Troudi, 2010; Almalki, 2011). Lecturers are struggling to design any activity involving such a large number of the students, meaning that the majority of the students cannot join in with learning activities, distancing them from their own learning. In these settings, face-to-face interaction between students and lecturers will be reduced or absent.

Lack of interaction can decrease the percentage of students' attendance (Bousbahi, 2014). In many cases, students are simply listening to the information delivered by the lecturer, allowing students to disengage. This is the most common mode of learning in lectures given in Saudi Arabia's Universities (Almalki, 2011). Therefore, students do not have a real role during the learning process, leading to boredom, which will lead to students missing lectures and reduce their engagement and attention. In the traditional lecture there is a low level of engagement and attention for students, with a low level of interaction.

Since there is poor face-to-face interaction, the silent mode of the learning process can lead to confusion and a lack of communication. Without face-to-face interaction, the teacher will have difficulty in determining whether their students understand what is being discussed (Alkhalaf *et al.*, 2012). Therefore, the lecturer gives lectures while unable to measure the students' understanding, unless quizzes are given until the final exam for the subject. Effective quizzes take time and effort to prepare and mark, and final exams occur too late to be of use to the teaching process.

With that, there is a belief among some lecturers that particular technologies are not suitable for teaching and learning (Almalki, 2011), for example, using computers or online resources for learning. This belief comes from a lack of computer and internet literacy for many teachers in the Saudi context, meaning many lecturers prefer not to use technology for their teaching (Amoudi & Sulaymani, 2014). Moreover, the lecturers may have low self-confidence` when it comes to using technology for teaching and feel using the traditional pattern to deliver information more effective. They think introducing new technology may

lead to having more responsibility, and therefore spending more time and effort to prepare for their lectures, which they do not have.

Much evidence exists in the literature of Saudi lecturers clinging to the traditional learning process, making it slower and consequently slowing the ability of students to acquire knowledge (Alfahad, 2012; Amoudi & Sulaymani, 2014). The quality of learning in Saudi education institutions does not match the target objectives for the government, emphasising a need to integrate technology to improve the quality of learning.

4. Exploring the gap

Universities in Saudi Arabia aim to provide students with the necessary knowledge and skills to prepare them for real life and the work environment. Additionally, students learn appropriate behaviour, so they can cope with and serve their society. There is a growing awareness that the development of individuals and communities relies on a good quality of education with successful learning and teaching (Fisher, 1995). Fullan and Hargreaves (1992) add that:

"*A fundamental purpose of education is to prepare young people for life in society, and since societies throughout the world are constantly changing and developing, education can also be expected to change*" (p.36).

In order to achieve this aim, some components need to be available and effectively connected with each other. For example, instructor, students, curriculums and the strategies for teaching and learning. Pring (2000) asserts that:

"*Education is concerned with the life of the mind, and such a life can atrophy if not carefully nurtured. The job of the teacher is to facilitate that development through putting the learner in contact with further experience or with what others have said (in literature, say) as they make sense of similar experiences*" (p.13).

All the components need to be highly appropriate for learning to have successful outcomes. Instructors need to be qualified and students need to be motivated to engage in the learning process. Additionally, curriculums need to be valuable and suitable for the aims of learning. Nevertheless, the strategy for teaching and learning might be the most important factor to transform the objectives to a successful outcome. The common strategy for teaching and learning in Saudi universities is transmissive learning, where instructors have the main role in delivering the information while students simply listen. An alternative strategy is constructivist learning, where students interact with each other and with their instructor to construct their understanding. The Ministry of Education recognizes the importance and potential of modern technology to change the form of learning in KSA, particularly in Higher Education (Weegar & Pacis, 2012). However, many technologies have been implemented in teaching and learning, while only few are suitable for use in lectures. One such recently introduced technology is PRS and already the effectiveness of this technology in this context is clear. It allows all the students to engage in learning during lectures and interact with each other. However, it needs deeper investigation to evaluate its effectiveness for learning development.

5. The purpose of the study

The common methods of teaching practice rely on the traditional lecture format familiar in Higher Education institutions (Chung, Shel & Kaiser, 2006). The traditional lecture here refers to the teacher-centred method, where the lecturer teaches and the students listen to the information. This method is the common one in the Higher Education institutions in Saudi Arabia. The studies show this pattern of learning is not effective, and they suggest other patterns to improve

interactivity and learning, such as PRS (Chung, Shel & Kaiser, 2006; Herreid, 2006). These studies have shown PRS has improved learning, students' satisfaction, increased interaction, increased achievements and grades, and improved knowledge retention. Some Saudi universities have tried to change the patterns of learning from teacher-centred to student-centred by introducing new technology, such as PRS. In this study the effectiveness of using PRS for learning development will be evaluated, as this new technology was introduced by King Khalid University. The evaluation of PRS will rely on Activity Theory (AT) as a lens to understand the use of this technology in the educational environment. Using AT, I will consider all components in the educational environment (students, instructor, subject, rules for the activity, PRS technology and the objective for the activity). The relationships between these components will be the main target for the study to understand the transformation of the objectives to outcomes. In order to achieve this, the following research questions were chosen:

The Research Questions

1) How does PRS influence relationships in the context of education?

2) How does PRS influence the students' experiences in the education environment?

3) What are the implications of using PRS?

6. The significance of the study

Education technology is an important factor in Higher Education nowadays and plays a vital role in the improvement of teaching and learning in higher learning institutions. Therefore, the use of the technology should be effective and the technology itself must be suitable to its context and purpose. Additionally, the

strategy for using technology needs to be effective to reach objectives. Therefore, the potential significance of this study and its value lies in the following:

i. Using Activity Theory

- Utilising AT as a tool to analyse participants' views of using PRS for learning development and how this technology helps them to achieve their objectives.
- The study emphasises how AT is vital in exploring the interactions, complex relationships and contradictions among different activity systems with common objectives.
- The study shows two activity systems with students and lecturers interacting to achieve common objectives, and provides strategies to understand the interaction between both activity systems.
- The study shows how AT is consistent with the constructivist paradigm, epistemology, methodology and methods of data collection.

ii. Higher Education development

- This study is providing an approach for the development of learning in Higher Education by providing a greater understanding of the process of learning during the PRS activity.
- Graduate students are expected to be highly qualified and that will have positive impact on their skills and knowledge and, consequently, on their future work.
- The findings from this study may encourage educators and policy makers in Saudi universities to improve their policies for using technology.
- The findings from this study are going to help universities to improve the use of technology for teaching and learning.

- Other universities in the region may use the findings and the considerations herein to improve their use of available technology.

iii. Significance in education research

- The findings of this study may offer opportunities for researchers to do further research in this area on using technologies and introducing new technologies to Higher Education.
- The study will contribute to the literature on this subject and attempts to develop best practice in research of technology.
- More significantly, the study will show the value of the constructivist paradigm in understanding the use of technology and choosing the best possible research methods.
- The study also offers greater insights into an innovative theoretical framework, in this case, AT.
- The study offers researchers, particularly in the context of Saudi Arabia, with appropriate paradigms, epistemology, methodology and methods of data collection, which are consistent with one another and with the theoretical framework.

7. Why carry out this research?

In recent years, many countries have been concerned with finding the best approaches to introducing a new technology, using technology effectively and understanding the effectiveness of using technology, in all parts of life. Thus, technology has been increasingly implemented in Higher Education institutions around the world (Sharpe *et al.*, 2006) because it offers the opportunity to learn with greater flexibility in relation to time, place, pace, entry and exit (Turney *et al.*, 2009). As educator, the research is concerned with the effectiveness of using technology for teaching and learning in Higher Education and specifically with

using PRS as a new technology in Saudi universities. This interest focuses on enhancing learning through using technology for teaching, from being a student in general schools, graduating from King Abdul Aziz University, then later teaching in general schools and at King Khalid University in Saudi Arabia. Over the course of time, the researcher experienced many difficulties in learning, as both a student and in teaching. These difficulties emerged from different aspects. One such is the number of students in each class; larger classes do not help students to focus and reduce the possibility of interacting with other students and the lecturer. Moreover, the current learning strategy does not encourage students to engage in learning. As instructor, it was quite difficult for the researcher to implement any strategy for active learning and allow interaction because of the lack of time, the amount of content and no available technology. Additionally, there are insufficient studies in the Saudi context about using PRS technology to increase interaction and using AT as a lens to understand its application. Moreover, the majority of previous studies that took place in the context of technology for teaching and learning used quantitative methods, which are more objective and do not offer a deep understanding about the use of technology. As a government sponsored student, the researcher is required to come up with findings and recommendations to improve the use of technology in education and help to change Higher Education policies in KSA for using technologies in teaching and learning. With the above experience and requirement, the researcher is able to look at the PRS activity from the inside; as a PhD researcher at Plymouth University, the researcher is also able to look at the activity from the outside. This unique perspective allows me to achieve the aims of this study by exploring the strengths and weaknesses in PRS activities and give recommendations for further improvements for using this technology.

Using AT as framework for the study is key to an effective analysis of the use of PRS technology. The use of AT has helped to discover two activity systems in PRS, which was helpful to understand the activity more completely.

8. Overview of the thesis

This thesis comprises eight chapters, of which the first chapter acts as an introduction. In this chapter, the existing knowledge gap, aims of the study, significance of the research and the rationale of the research are illustrated. Moreover, some information about the context of study is presented in this chapter.

The second chapter concentrates on reviewing the related literature, defining PRS, the components of PRS, the history of PRS, explaining terms related to PRS and overlap between these terms, the pedagogical use of PRS and the best practice of PRS, preparing high quality questions for PRS activities and the use of PRS in Saudi Arabia.

In the third chapter is the theoretical framework of the research, specifically Activity Theory. It provides detailed information about the history and background of Activity Theory, its generation and principles, and how AT shapes research. It discusses the importance of Activity Theory as a theoretical framework for understanding the interactions, complex relationships and contradictions among different activity systems with common objectives, which is essential to developing the learning process.

The fourth chapter is the methodology, which focuses on the research design. The research paradigm, ontological assumptions, epistemological assumptions and methodology are illustrated in this chapter. In addition, the methods and procedures of data collection and analysis are discussed. An explanation of how

Grounded Theory will inform data collection data in this study will be included. This will highlight the importance of the constructivist paradigm in educational research and how this, along with the paradigm, ontological, epistemological and methodological assumptions are all consistent with AT.

In the fifth chapter, the quantitative findings of this study will be presented, from the questionnaires. This chapter will include charts and tables to represent the findings and discuss them.

In chapter six the qualitative findings will be presented in the light of the research questions, with reference to aspects such as subject, objectives, tools, community, rules and division of labour which will shape PRS activity.

In chapter seven, further discussion of the results of the interviews and questionnaire will be given, using Activity Theory to present two activity systems for students and lecturer. The discussion will use ideal types to summarise the findings and to explore how interaction, complex relationships, the implications of using PRS in this manner and contradictions in PRS activity.

Chapter eight comprises conclusions and recommendations which could help to improve the effective use of PRS in Higher Education in Saudi Arabia. In addition, some suggestions for further research are given. Finally, the way ahead for effective implementation and use of technology in Higher Education is presented. In the following chapter, existing literature about PRS in different contexts will be presented and the knowledge gap will be explored.

Chapter 2: Literature review

1. Overview

This chapter aims to draw together various bodies of literature which provide background for this study. This chapter will focus on the use of the Personal Response System (PRS) in Higher Education generally, and specifically in Saudi Arabia. As mentioned in the introduction, the main approach of teaching in Saudi Higher Education is traditional, which may be a result of inherited experience or ways of teaching adapted from Islamic principles and the Quran. Previous studies of using PRS in Higher Education indicate that there are positive and negative effects of using this technology. The history of using PRS in education and the available types of PRS are briefly included in this chapter. Moreover, the current knowledge regarding Higher Education in Saudi Arabia will be presented, which will highlight gaps in the available literature. Additionally, this chapter describes methodologies used in previous studies and analytical methods used in relation to PRS. This will help to generate a framework for this study, the appropriate methodology for which will be presented in chapter 4.

2. Context of study

In this research, the study will be situated in Saudi Arabia. The Kingdom of Saudi Arabia is located in the Arabian Peninsula and occupies around 2.25 million square kilometres, lying in a strategically important position. It is the largest country in the region and the place where the religion of Islam was born, more than 1,400 years ago (The Ministry of Finance, 2015). The population of the kingdom is around 23 million, 50.4% male and 49.6% female, with a high percentage of people under 30 years old across both genders (Central Department of Statistics, 2014). The kingdom was united by King Abdul Aziz in 1932 and Riyadh was chosen to be the capital city. Since 1932, the Kingdom has been continuously governed by the Royal family, up to the current King Salman.

Education has been an important sector for the government since the unification of the country from its previous regional divisions. A lot of effort and a large budget were committed toward the development of this vital sector. One result of this was the establishment of universities in the Kingdom, bringing the number of government sponsored Higher Education Institutions (HEIs) to 33. From the establishment of the Ministry of Education as provider for education, challenges in HEIs have been met by offering possible plans for improvement although this was the effort to improve learning, the styles of teaching and learning have remained the same. The teacher is still the main source for information and students normally receive the information passively without a real involvement in the learning process.

Nowadays, there is a big competition between Higher Education institutions (HEIs) worldwide to market their educational products (Ramasubramanian, 2012). The only differentiating factor is the quality of teaching and learning in the institutions (Al Kuwaiti & Subbarayalu, 2015). There is an awareness of the importance of the quality of the education in Saudi Arabia due to the increase in the number of students in HEIs and the need for highly qualified graduates for the labour market. There are many ways to measure the quality of education in a university, including attracting employers, the success of the students in their jobs and their ability to secure their well paid jobs(Naidoo* & Jamieson, 2005). Some universities have some systems in place to monitor and measure teaching performance (Douglas & Douglas, 2006). Many universities have paid attention to student reviews about teaching and the quality of their curricula, because they are the target for universities (Alderman, Towers & Bannah, 2012). Employing students to evaluate teaching performance and education quality is the most preferred method (Lekena & Bayaga, 2012). The obtained information

from the students can be used to identify the strength and weakness of the education and make improvements for the future.

2.1. Teachers' behaviour toward using technology in Saudi Universities

Despite the budget provided by the Saudi government and the availability of the technology, teachers are still resistant to using technology in their teaching for many reasons, and prefer to use the traditional approach (Alfahad, 2012). The teachers' behaviour is affected by feelings, perceptions, beliefs and previous experience, along with the manner of teaching inherited from the Islamic religion. According to Alfahad (2012) these are the most important factors that inhibit the incorporation of technology into Saudi Higher Education. These factors have been discussed time and again in many studies in various contexts (Albion & Ertmer, 2002; Grasha & Yangarber-Hicks, 2000). These factors are related to teaching practice and how the lecturer performs in the classroom, as well as their previous experience and beliefs. If their experience using technology was positive, and they found the technology easy to use, they are likely to use it in their teaching. If their experience was poor, the lecturer is unlikely to use it (Nye & Silverman, 2012).

Additionally, every lecturer prefers a different style of teaching to deliver information to students. Their preferred teaching style and the suitability of technology for that teaching style influences their acceptance of technology. This complies with the Technology Acceptance Model TAM, which is a theoretical framework that explains and predicts user acceptance and behaviour toward specific technology (Park, 2009). This model explains the factors that may influence a user's acceptance or rejection of technology. Some teachers prefer

not to use technology for teaching because they simply prefer not to. The decision to integrate technology into teaching relies on teaching style and a teacher's strategy if they see the usefulness for teaching with technology (Alfahad, 2012). Therefore, teachers' beliefs affect the use of technology in teaching.

Moreover, the lack of technological skills is a major barrier for the integration of technology into teaching (Alfahad, 2012). The deficit in technology skills is due largely to a failure to offer teacher training on how to use new technology, or a failure to offer early instruction for when they join Higher Education. Building teachers' confidence through offering training programmes encourages them to develop their use of technology in teaching. Using technology without training may have a negative impact on the learning process. Introducing new technology without effective training may increase lecturers' anxiety towards using it.

In addition there are other factors that may adversely affect teachers' ability to use technology for teaching. These factors include a lecturer's age, demographics, class size and support from the university (Wozney, Venkatesh & Abrami, 2006). The age of a teacher is one of the factors that may affect their willingness to use technology for teaching. Older teachers may not be as motivated as younger teachers to use technology, or may not have as much knowledge or training as the younger teachers. Additionally, nationality may affect using technology for teaching, as Saudi lecturers have more job security than non-Saudi lecturers (Alamri, 2011), making Saudi lecturers reluctant to make long-term changes to improve their implementation of technology in their lectures.

The number of students in each class may also affect the use of the technology. Using technology with a large number of students may result in difficulty in

managing students and learning activities. There is no specific gauge to classify class size (Kelley & Maushak, 2004). However, a large class size has been defined as a large distance between a first row and last row where students do not know each other (Trees & Jackson, 2007). Class sizes differ in Saudi universities, varying from 5 students to more than 300 students in one single lecture.

The Saudi government has assigned a substantial budget to integrate technology in education for teaching and learning (Alfahad, 2012). However, many Saudi universities do not provide full support for lecturers using new technology or offer poor quality support. This does not motivate teachers to use technology. Proper support includes training for teachers to use technology and the management of technical problems during lectures. One of the factors for successful technology implementation is offering long-term support for using technology as part of the education strategy of the university (Buabeng-Andoh, 2012; Mumtaz, 2000).

Generally, teachers and students believe technology has changed their roles in Higher Education in Saudi Arabia (Alfahad, 2012). However, studies conducted in the Saudi context rely on quantitative data and there is no clarification for the teaching and learning roles or the changes technology brings about. Alfahad (2012) highlights the importance of cooperation between individuals and departments of HEIs in a Saudi context to support the successful implementation of technology. Components include teachers, students, technology departments and the management of universities.

2.2. Student behaviour toward technology in Saudi Arabia

In recent years, the number of the students enrolled in Saudi universities has increased rapidly (Alkhalaf *et al.*, 2012). The response of the Ministry of

Education to this increase was increasing the implementation of technology for learning. This has changed students' perceptions as they feel they are more able to learn with technology than before (Alfahad, 2012). However, Saudi students face difficulties that influence their behaviour toward using technology for learning. One such barrier is poor skills in using new technology (Alkhalaf *et al.*, 2012). Students may not be comfortable learning with technology with which they have no previous experience. Additionally, they may be distracted, or unable to progress as they do not know how to operate the technology for formal learning. Therefore, it is essential for students to receive some training before they start to use any form of technology for formal learning (El Mansour & Mupinga, 2007).

Nevertheless, some kinds of technology can be easily used without much training. Consequently, students will be more eager to learn using simpler types of technology. Moreover, when they encounter difficulties they will struggle less to solve these problems. One technology that falls into this category is PRS (Guiller & Bell, 2011; Rodriguez & Shepard, 2013; Van Daele, Frijns & Lievens, 2016).

3. The Personal Responses System (PRS)

In the available literature, PRS is known by many names (Alamri, 2011; Barber & Njus, 2007; Barragués, Morais & Guisasola, 2011), including the Personal Response System (PRS), clickers, the Audience Responses System (ARS), the Student Response System (SRS) and the Interactive Response System (IRS). Throughout this study I will use 'Personal Response System (PRS) as the generic term for this tool. The introduction of this technology has caught the attention of governments and Higher Education institutions all over the world (Kennewell *et al.*, 2007). PRS is a handheld, pocket-sized remote control with two buttons or

more, enabling teachers to pose questions and students to receive and answer these questions. PRS technology contains three components, namely clickers (handheld), receivers and software.

PRS are small wireless handheld transmitters that allow students to submit their answers. The process of asking questions starts with the presentation of slides using PowerPoint, which contain the PRS questions. The clickers are activated as soon as the slide is shown, and when the time limit is reached the receiver automatically will stop receiving responses from participants. Alternatively, instructors can stop the voting at any time without a specified time limit. The responses will be collected, calculated and displayed in the form of a histogram on the main screen to show the percentages of votes, correct or incorrect answers. According to DeBourgh (2008), the percentage of responses can be an indicator for the pattern of the answers. For example, if the percentage for the answers is relatively similar on all options then the students are guessing the answers. Conversely, if the percentage is high for one or two answers that is an indication that answers are being chosen honestly and the questions have been created accurately.

However, relatively similar answers for all options might not indicate that students are guessing the answers, but that the question is too difficult or phrased incorrectly. On the other hand, selecting one answer might be indication for asking a very simple question so students with different levels of understanding can answer it easily. Educators face challenges in implementing PRS technology in classrooms because they need to make sure the technology is pedagogically suitable and can support student development. Some technologies come with specifications (speed, accuracy, automaticity and interactivity) which might be

favourably disposed toward enhancing learning and teaching (Caldwell, 2007; Meedzan & Fisher, 2009; Simpson & Oliver, 2007; Van Daele, Frijns & Lievens, 2016).

PRS has been defined as an educational technology to be used by the instructor to promote interactivity in face-to-face settings. This is achieved through receiving students' responses and showing results in a histogram format (Bruff, 2007). The system provides an alternative method to the traditional approach, where students individually raise their hands, or show coloured cards to answer and interact or show agreement about a specific statement. Bruff (2007) reported that teaching with technology such as PRS is an important move from the traditional approach to a more engaged approach. In other studies PRS has been described as technology that provides opportunities for anonymous individual responses from the students, where the traditional approach would publicly expose students' answers. Answering the instructors' questions anonymously is motivation for students to engage in learning in a safe manner (Draper & Brown, 2004; Laxman, 2011), simultaneously enabling the teacher to assess students' understanding. The first public appearance of PRS was in a TV show called "*Who Wants to be a Millionaire?",* where the TV presenter would ask the audience for a group response in a similar manner to a lecturer asking his students' questions (Caldwell, 2007; Rana & Dwivedi, 2016). Further information about the history of PRS can be found in Appendix 16.

4. Affordance Theory

Affordance theory is a theoretical construction representing the potential for an action to occur between user and object (Gibson, 1977). The majority of definitions consider only the physical affordance between the users and the

objective. Nevertheless, the perceived affordance is essential as the user needs to be aware of it, either physically or psychologically (Nye & Silverman, 2012). Nye and Silverman (2012) defined affordance theory as perceived affordance, whereby the user is aware of the affordance through direct perception or experience. The second definition is unlike the first, as the first focuses more on the relationship between the user and the object. The second definition relates to the perceived affordance of the user based on his/her perception or experience when considering the relationship between the user and the tool. For example, the possibility of opening a door using a doorknob by the user is affordable if there is prior experience of successfully using a doorknob for this purpose. The doorknob presents an affordance for the user to perform the action of opening the door. If the user is not able to use his/her hand or the doorknob is broken then there is no affordance. The purpose of using affordance theory, therefore, is to understand the user perception of an object (PRS in this case).

The user perception of an object will indicate possible actions for using that object and how the user is aware of these possibilities. Therefore, affordance describes actions perceived by the user with the objects. Affordance illustrates the relationship between the user and the environment, as some parts of the environment might be important to perform the actions. Without these parts the user might not be able to perceive or perform the action (Nye & Silverman, 2012).

Perception is an important fact to guide the user to beneficial action. Without it, the user might not be able to perform the correct action. The concept of affordance corresponds with Activity Theory as all the elements of the environment are interacting with each other to transform the objective to an outcome (Engeström, Miettinen & Punamäki, 1999). In other words, a false

perception of the tool will not allow the activity to proceed. Therefore, a clear understanding of the function of PRS will help to advance the activity; if not then the activity may not proceed. Confusion appeared around the concept of the affordance as originally presented by Gibson (1978), which resulted in an effort by Norman (1988) to simplify the original concept (cited in Nye & Silverman, 2012). Norman used the theoretical framework for human computing (figure 1). The following figure shows the relationship between affordance and the user's perceived information or experience. The x-axis shows "yes" if the affordance exists and "no" if it does not exist. The y-axis shows if the perceptual information exists "Yes" or does not exist "No".

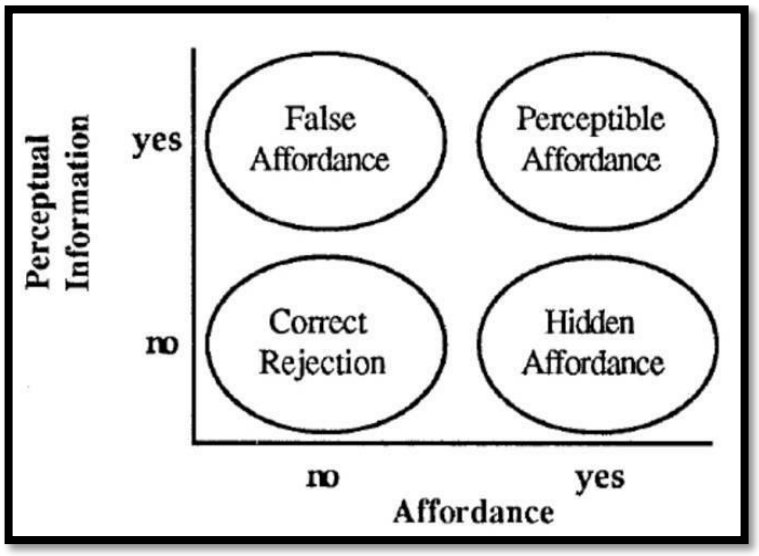

Figure 1 Affordance Theoretical Framework (Nye and Silverman, 2012)

If there is affordance but no perceptual information, this will lead to *Hidden Affordance*, while if there is perceptual information but no affordance, this will lead *False Affordance*. On the other hand, if there is no affordance and there is no perceptual information, this will lead to *Correct Rejection*. The action will be performed only if both perceptual information and affordance are present (Nye & Silverman, 2012).

Therefore, affordances are the interactions between users and tools. The tool prompts, guides, or constrains the users depending on their previous experiences. In order to accept the affordance of the tool, the user must have prior experience with similar tools to apply domain knowledge and must be at an age where they are able to understand or relate to the affordance (Kay *et al.*, 2006). Affordance Theory has been increasingly used within the study of education technology (Day & Lloyd, 2007). The rationale for using Affordance Theory to study education technologies is to give potential to the value of the technology in the context of the learning process and show the effects of users' previous experience. The theory highlights the possiblities of improving learning using technology, with consideration to the affordance and specifications of technology in the context of the previous experience of the user. There is plenty of evidence in the literature to support the affordance of PRS as a technology that increases interaction, participation, attention, assessing understanding and offering feedback to improve the learning process (Dagarin, 2004; Gachago, Morris & Simon, 2011) . Therefore, using Affordance Theory is a valid approach in this research, as it will focus on participants' perceptions and their previous experiences with the functionality of PRS tools.

5. Learning Theory

In recent years, many technologies have been introduced into Higher Education to improve learning (Weegar & Pacis, 2012). In order to make the use of technology meaningful and to ensure successful learning, it is necessary to reflect upon learning theories. The two main learning theories commonly used and discussed in the context of technologically supported learning are social constructivism and behaviourism. Historically, both theories have been used in developing education technologies. Moreover, their influences are also both

prominent in contemporary ET. Therefore, it is essential that we examine the implications these theories have on the future of education technology. Behaviourism and constructivism are learning theories developed from two philosophical schools of thought that have influenced our perspectives on learning. Behaviourist learning theory was developed by Skinner and Watson to describe how behaviour could be observed, predicted and controlled (Skinner, 1974). Their aim was to discover how learning might be influenced by changes in the environment. The behaviourist view of learning posited that changes in behaviour should be "*measurable and observable*" and there was no interest in unobservable phenomena, including what occurred inside the mind (Bush, 2006).

Vygotsky and Piaget were the main developers of constructivist theory, which offered an explanation of learning as constructing knowledge through schema. For Vygotsky, meaning was negotiated in a social context through interaction with other individuals and described elements that helped predict what students understand at different stages of development (Rummel, 2008). For Piaget, learning occurred largely as a result of knowledge construction through interaction with the environment and with tools. Piaget's view of learning was through cognitive development, whereby the learner assimilates new knowledge through exploration, but also needs to construct their understanding within the context of prior personal experience. Piaget believed learning is "*achieved through observation and experimentation whereas Vygotsky viewed it as a social process, achieved through interaction with more knowledgeable members of the culture*" (Rummel, 2008), (P.80). Therefore, Vygotsky referred to the same concept of constructing knowledge as Piaget but placed more emphasis on learning without any help from another individual (Papalia, 2011). The difference is apparent in the

limitations of the teacher role. In Vygotsky's theory, the teacher plays an

important role in the social context of learning, acting as more knowledgeable than the learners, whereas Piaget believed the learner learns in a social context but without help from teacher (Papalia, 2011). It seems that considering the social context and other learners and teachers is effective for understanding the learning process. The learner interacts with other individuals and learns from their experience, their understanding or their feedback.

Considering Piaget's view of the learning process through observation and experimentation, the social factor plays an important role for individuals learning and building knowledge. Therefore, both Vygotsky's and Piaget's views work well together. Piaget's theory constitutes the learning tasks in the classroom and Vygotsky's theory of social interaction can be used when the students are performing the tasks (Schayer, 1997).

Learning activities in social constructivist learning environments are characterised by active engagement, inquiry, problem solving, and collaboration with other individuals. Rather than delivery of knowledge, the teacher is a part of the learning community (classroom) and acts as a guide and facilitator for the learner, and as a co-explorer who encourages learners to question, challenge, and formulate their own ideas, opinions, and conclusions. This contrasts with the teacher role represented in behaviourist learning theory, where the learning is teacher-centred and the teacher leads the learning activity. The following table shows the differences between Behaviourism Learning Theory and Social Constructivism Learning Theory.

Behaviourism	Constructivism
Directed Instruction	Non-directed Instruction
Objectivist	Constructivist
Teacher-centred	Learner-centred
Behavioural observations	Cognitive operations
Focus on the individual	Group work is emphasized
More focussed on one approach	More holistic in approach

Figure 2 The differences between Behaviourist Theory and Social Constructivist Theory (Forrester and Jantzie, 1998)

Those who oppose behaviourist theory believe that it failed to take into consideration the influence of the mind while overemphasising observable behaviour. Instead of involving students in solving problems, behaviourists use methods of direct instruction (i.e., lecturing and teaching skills in isolation) and assess student learning based on responses to questions in oral or written tests. Constructivists White-Clark, DiCarlo and Gilchriest (2008) state:

"*presenting the role as 'guide on the side' requires teachers to step off the stage, relinquish some of their power, and release the textbooks to allow their students to be actively engaged and take some responsibility of their own learning*" (p44).

Furthermore, constructivism involves developing students as learners through cooperative learning in group work, experimentation, and open-ended problems

in which they can learn on their own through active participation with concepts and principles (Kearsley, 1994 cited on Weegar & Pacis, 2012). This approach is compatible with using the latest social technology in learning, while behaviourism focuses on individuals.

Therefore, the main difference between constructivism and behaviourism is the perception of learning. Whereas a behaviourist is concerned that content is to be learned through the influence of the environment upon that learning, constructivists are more focused on knowing how the learner attempts to construct meaning in a social context (Bush, 2006). An example of the behaviourist approach is when a student uses PRS, s/he tries to use it differently every time. His/her behaviour will change from trying to use the keypad to using it effectively and learning to respond to the questions. Skinner (1976) (as cited in Weegar & Pacis, 2012) stated that the mind and mental processes are "metaphors and fictions," and that "behaviour" is a function of the "biology" of the organism. From this example we can understand the behaviourist is more interested in human behaviour rather than the processes that might occur in the human mind.

Additionally, behaviourists view learning as an individual action for learners, whereas constructivists view learning as a social process within a group of individuals (Weegar & Pacis, 2012). The behaviourist perception of educational technology is that it is a tool used to reinforce student behaviour for learning.

Educational Technology (ET) plays a role in connecting individuals to increase interaction. Therefore the emphasis shifts from behaviorism to social constructivism, using education technology to support peer learning and problem solving (Weegar & Pacis, 2012). Peer learning is not common in Saudi Higher

Education, or may be totally absent. The concept of constructivism is that the learner is actively engaged in constructing their knowledge based on their own experiences in the social context. This concept has offered advantages over behaviorism when utilising technology and explaining its strengths and weaknesses.

The current education approach in Saudi universities is based on behaviorism, whereby learning is achieved through teacher-centred methods. The teacher leads the learning activity by delivering the content and the student acts as a receiver of that content. There are efforts to incorporate constructivist learning approaches into classrooms in Saudi Arabia by educators from the Ministry of Education (Al-Abdulkareem & Hentschke, 2014), including attempts to promote methods where students become more responsible for their own learning. It is hoped that these moves will change teaching strategies through the introduction of new technologies which help to increase interaction and peer-instruction.

This theory might be effective for students and the learning process in the Saudi education system (Alsulami, 2016). This is because students may become more independent in their learning. The main approach in Saudi Higher Education is the traditional method, which is based on rote memorization and is highly teacher–centred. This type of teaching helps students in the classroom to achieve high marks in the exams, however it may not help students outside the classroom or in real life after graduation (Yager, 1991). This issue is prevalent among students who forget what they have learned after the exams and are then not able to practice what they learnt outside of the classroom (Alsulami, 2016). The constructivist learning approach may offer impetus to change the format of education in Saudi. This approach relies on both cognitive–developmental and

social constructivism which contrast significantly from the traditional lecture method. Applying this approach might encourage students to engage more deeply in learning and share their knowledge more freely with teachers and other students.

Both learning theories are suitable for the analysis of the use of PRS to support learning, however it is not possible to assess cognitive processes of learning using behaviourist theory. PRS activity is based on encouraging problem solving by asking questions and creating challenges for students. Moreover, this technology supports peer-learning and interaction as has been reported in many previous studies. Social constructivism is compatible with the strategy of PRS use, and all the advantages of using it, for example, increasing engagement, interaction and participation.

6. Vygotskian Sociocultural Theory

The concepts of internalization and externalization have become popular since 1978 after the publication of Vygotsky's work, Mind in Society (Zittoun & Gillespie, 2015). These concepts show how the social world becomes a part of the learner and how the learner becomes a part of the social world. Internalization was defined as an operation whereby a person interacts with other individuals to internalize values and knowledge (Vygotsky, 1997 cited on Fernyhough, 2008). According to this definition operations, social interaction, cultural concepts and knowledge are internalized by the learner and cannot be internalized or constructed by others.

The learner can modify knowledge during internalization, and adopt values based on previous experience. When the learner internalizes values and knowledge, these will be externalized in the form of actions, behaviour and language. The

concept of internalization leads the teacher to give students general information and then the students will need to work on a task or solving problems rather than relying on the teacher for obtaining specific knowledge (Turuk, 2008). The production of knowledge is achieved through dialogic and social interaction; this process will influence student internalization of beliefs, thoughts and behaviours (Bowler *et al.*, 2005).

Therefore externalization is an active and transformative process. During this process a learner transforms and externalizes knowledge and values through interaction with other learners. Internalization and externalization operate continuously during the learning activity and these operations are not "inseparably intertwined" (Engeström, Miettinen & Punamäki, 1999, p.10). Both operations are inspired by AT and emphasise the concept of a meditated artefact. However, these operations will be guided by the instructor and this was illustrated in the Zone of Proximal Development (ZPD) theory, which will be discussed in the next chapter. Vygotsky (1978a) pointed out in this concept the learner needs assistance during learning activities to internalize and externalize concepts and knowledge (Agbatogun, 2014). The (ZPD) is learner-centred and contrasts with teacher-dominated instructional processes. Additionally, the concept of ZPD is associated with scaffolding of learners (Guk & Kellogg, 2007). The concept of scaffolding in learning refers to the gradual shifting of responsibilities from the instructor to the learner to facilitate learning and development for the learner (Verenikina, 2003). Through the interaction between instructor and learner, the instructor will be able to identify the learner's ability to understand, and their weaknesses, and will provide possibilities to choose the most suitable content or tasks for learners to develop their ability to construct their knowledge. However, the teacher's role is purely assistance and guidance while the learners work and

interact with other learners to construct their learning. Therefore, there is a need to spread these concepts in education to provide opportunities for teachers to guide students to construct their learning (Agbatogun, 2014), especially in Higher education in Saudi Arabia.

In many Saudi universities, education is based on didactic teaching or teacher-centred education, whereby teachers lead the learning activity and the learner has less responsibility towards their learning. Teaching refers to a responsibility to achieve students' objectives through the necessary assistance that would enhance the achievement of their objectives. This help cannot only be restricted to the teacher, but other learners can play an important role in helping one another reach their objectives. That was showed in a study done by Mitra (2003). The study shows that students who were given access to public computers taught each other by using search engines, chat and emails. Therefore, interaction with other learners might be essential towards achieving the objectives for learners with assistance from their teacher (Kao, 2010b). Therefore, teachers should encourage students to interact and discuss knowledge to ensure effective collaboration in knowledge construction.

7. Definition of terms in PRS studies

Numerous studies have been undertaken on the use of PRS and their effects on the educational environment. Many descriptive terms for this area have been developed, some related to students, others to instructors and many concerning both. Basically, PRS has been used to improve student interaction, engagement and attention (Draper & Brown, 2004), increase attendance (Bullock *et al.*, 2002), as an incentive for peer and class discussion (Pelton, Francis & Epp, 2009), provide feedback for both students and instructors in order to improve instruction

(Caldwell, 2007) and to improve learning performance (El-Rady, 2006). However, the terms, when used for searching the effects of PRS, have different definitions from one study to another and from author to author. Therefore, a precise definition of terms will help gauge the extent of the effects of PRS on the learning process and the educational environment.

This section will define the terms used in PRS studies, to explore the methods used to critically evaluate the relationships and overlaps between these terms.

7.1. Engagement

Fundamentally, student engagement is an essential factor for learning in an educational environment. Students are engaged when they become involved during the class and feel they can contribute to a lesson (Bandaranaike & Willison, 2011). In addition, students' engagement may give indications of their ability, requirements or compulsion to participate in the learning process to develop their level of thinking (Bomia *et al.*, 1997). Trowler (2010) defined student engagement as interaction between time, effort and other associated resources by students and their institutions with the intention of optimising the student experience and enhancing the learning outcomes and development of students and their performance. However, in the PRS literature, definitions of the concept of student engagement vary from study to study. In one PRS study, engagement was defined as stimulating students' awareness periodically throughout the lecture by using PRS, as this practice was new and fun for them (Patry, 2009). On the other hand, O'Donoghue, Jardine and Rubner (2010) defined student engagement as moving from passive retention to active learning in lectures through the use of PRS.

From a social constructivist point of view, students need the opportunity to engage with their environment by providing what they need to learn and allowing them to construct their learning through interacting with other individuals in the classroom (Hein, 1991). Based on this view the engagement of students can be defined as paying more attention to learning in the classroom, feeling more involved and motivated in the learning process, actively participating in interactive activities and thinking creatively via the use of clickers in class (Liu, 2008). These findings confirm that learning occurs in a social context and engagement is the result of providing the conditions to allow students to engage with using PRS.

Quantitative student surveys were used in a study measuring the level of engagement (Gachago, Morris & Simon, 2011). Surveys were not the only method used to measure engagement. The observations and group interviews methods were also employed (FitzPatrick, Finn & Campisi, 2011). These methods were used because of the need to measure engagement as feelings and attitudes, for which these methods are well-suited. However ecological validity is higher when using observations as the student will be observed in an authentic environment while using the PRS.

7.2. Continuing Participation

In general, involving students in activities in a class, whether verbally or practically, is referred to as participation. Student participation leads to increased learning, which means this factor (students' participation) is fundamental for any educational environment and for learning (Stowell & Nelson, 2007). Klemenčič (2012) defined students' participation as their formal and actual ability to influence decisions made in the educational environment. These definitions are relatively similar to the conceptions of students' participation in PRS studies. Participation

involves students in the class sessions moving beyond the passive role characterised by traditional, large lecture formats (Cutts, 2006). In one study, student participation was defined as situations in which the student moves from being a passive recipient of information to an active participant in the learning process, whereby they can discuss their own experiences in the context of the class (Stagg & Lane, 2010). This definition corresponds to modern learning theory where students move from transmissive learning to constructionist learning. Within Activity Theory (AT) this definition refers to learning activities as a social activity.

The nature of the learning activity and the possibility for learners to take part in the learning activity can enhance the learning process. Thus, the learning is developed and supported in the environment where it has rich stimuli and provides possibilities for the learners to take part in learning (Austin, Orcutt & Rosso, 2001). According to Mula and Kavanagh (2009), participation in a PRS lecture reflects an ability to provide an opinion and complete answers during a lecture. Similarly, Masikunas, Panayiotidis and Burke (2007) agreed that engagement acts to produce active rather than passive learners. They argued that participation is based upon the students' responses during class, which rely on self-confidence, and are prompted through the use of PRS. Therefore, participation is the ability to contribute to the class activities, whether verbally or practically, to express an opinion or to understand within social settings.

Evaluating students' participation in the classroom can be achieved through different methods. These include PRS feedback questions, questionnaires (open-ended questions) and focus groups (Gachago, Morris & Simon, 2011). Nevertheless, other methods may be used to evaluate students'

participation, for example, interviews or observation. Kay and LeSage (2010), for example, used questionnaires to evaluate student involvement in PRS classes. All the aforementioned methods can be used, however qualitative methods may be the most appropriate to help to construct understanding about the possibility for students to actively participate in learning with PRS.

7.3. Understanding

The term understanding is a generic word for the ability of learners to process and make connections between concepts and their previous experience, and become aware of the activities taking place in the learning environment. Nevertheless, there is no accurate definition because some researchers have argued that understanding is the psychological process that enables memorisation of information. Others claim that the process involves more than memorisation, and includes being able to explain and apply concepts and evaluate them effectively (Bloom, et al, 1956 cited in Churches, 2008). Generally, the term 'understanding' has been defined variously in PRS studies. Roselli and Brophy (2002) conducted a study on the use of PRS to increase students' learning of the course materials at Vanderbilt University in the USA. The study was conducted with two undergraduate biomedical engineering courses, with a total of 76 students. The authors defined understanding as the process by which the students reflected on concepts that have just been presented, which allowed them to think about how they might explain or apply these new ideas.

Moreover, understanding involves actively improving cognitive skills from the lesson content with PRS (Pelton & Francis Pelton, 2008). These definitions illustrate some aspects of understanding but do not consider the deeper processes involved. This includes, for example, the influence of other individuals

in the learning environment and the previous experience of the learners. Examining understanding in these terms may deepen our appreciation of the processes by which students achieve ‘understanding’.

In a peer reviewed article, Kay and LeSage (2010) identified 50 studies that were conducted between 2000 and 2007, with 37 articles published in 2004; PRS questions were used to assess the students’ understanding and their knowledge. Open-ended questions were also used within the survey (Kay & LeSage, 2010). However, designing PRS questions should be done carefully to make sure students can assess the understanding of objectives and concepts efficiently. Nevertheless, this method can be time consuming and takes a lot of effort, because the researcher needs to create accurate questions, specify time duration and provide marking criteria for the exam. Therefore, the PRS questions and open-ended questions are suitable methods to evaluate understanding; also using interviews or group interviews can be an effective method to evaluate student understanding.

7.4. Student performance

Student performance is commonly known as the manner in which a student or a group of students perform. Student performance is identified in some studies as students’ achievement and in others as the students’ academic performance. In PRS studies, student performance means learning outcomes achieved (Stowell & Nelson, 2007). Moreover, Nosak et al. (2006) report that student performance can be shown through the students’ marks. The data suggest that the more students participated within the PRS system, the better they performed on the course’s final exam. In addition, Mula and Kavanagh (2009) defined student performance in their PRS study as the student grade at the final exam. Mareno,

Bermner and Emerson (2010) defined student performance as performing better in the course through the use of PRS technology.

In the majority of PRS studies student performance refers to the students' marks, nevertheless, it would be more holistic to include consideration of the level of involvement in the learning activity. The students' marks are a result of the students' understanding of the content and their involvement in the learning activity while using PRS. Thereby, the students' performance is described as being improved through the use of PRS and by achieving a higher grade in a course.

Another study measured the effect of PRS on student perception and academic understanding in courses in a health sciences curriculum for freshman level with 293 students at Merrimack College, in the USA. The questionnaire was used to measure the students' understanding from their own perspective (FitzPatrick, Finn & Campisi, 2011), in this study, PRS did not improve students performance in all the subjects. There was improvement in Anatomy and Physiology, but not in Pathophysiology. Moreover, exams were used to measure the students' performance in two groups, one with PRS and one without, within the same course (FitzPatrick, Finn & Campisi, 2011). According to Nosak et al (2006), the students' performances can be measured through the students' marks in their exams. Student performance is reflected in the student's grade at the final exam (Mula & Kavanagh, 2009).

However, Robinson and King (2009) reported that there is no correlation between using the PRS and the students' grade. The reason for this may be because the exam did not reflect the students' performance due to the format of exam, the difficulty level of the exam or other factors. Therefore, exam marks might not be

an effective method for measuring student performance, especially if the exam only gauges the principal concepts of the course. Thus, qualitative methods (observation and interview) may be more effective to evaluate students' performances from both student and lecturer perspectives. In this study there was no possibility to access students' marks for the exams at King Khalid University.

7.5. Interaction

Interaction is the degree of interactivity defined by some specialists in education (Cowley *et al.*, 2002) as communication and dialogue between students, and between students and their teacher. From a social constructionist perspective, interaction leads students to a point of reflection that causes them to evaluate existing assumptions of current information before choosing to integrate or discard the new information. Moreover, interaction can be classified according to various types of human to human, human to computer, or computer to computer interactions (Cowley *et al.*, 2002).

Interaction in a PRS lecture is achieved by a feedback loop in which a question is asked or an issue is raised. Questions are displayed to students by embedding the questions within PowerPoint slides. Once a multiple-choice question is asked, the use of clickers allows students to select their preferred option for the answer (Retkute, 2009). Student interaction is facilitated by the dynamic engagement between learners and by interaction with different factors in the classroom (Mula & Kavanagh, 2009), a dynamic that can be wholly represented in AT. Many different factors, therefore, interact with each other to achieve the objectives of the learning activity.

If the use of PRS activities could improve the communication quality and skills of students, and students could learn to respect the viewpoints of their peers, then

it is likely the interaction between lecturer and students, and between students would also occur and increase (Liu, 2008). Therefore, interaction could represent a high level of participation, wherein students not only participate but also share their understanding and receive feedback from the lecturer. Clearly PRS could allow learning to occur in a social context as lecturers and students interacted. This view of PRS activity corresponds with Vygotsky's social theory of learning (zone of proximal development or ZPD), where all individuals interact to learn (Vygotsky, 1978b).

In order to evaluate interaction, FitzPatrick, Finn and Campisi (2011) used dual methods of questionnaire and independent observation. The questionnaire contained items evaluating the students' perceptions about the interaction, allowing them to rate them. The questionnaire was also used by Mula and Kavanagh (2009) to evaluate the use of PRS to increase interaction. The data were collected from students enrolled in a first year accounting course over three semesters. The number of participants was 33, 61 and 26 students in semesters 1, 2 and 3, respectively. Independent observation was used to confirm the data from the questionnaire and it is usually done by one or more of the authors, who should be qualified to observe the level of interaction and assess whether these factors would increase or decrease it. Using both methods could achieve a clearer view about the level of interaction of students with PRS. However, interview methods might also be effective to capture students' perceptions and their feelings about increasing interaction with PRS. This combination of instruments may help to construct our understanding of the level of interaction with PRS.

7.6. Attendance

Students are expected to attend classes regularly. Classroom attendance is often one of the most necessary and important means of learning and, in many classes,

is essential to the educational objectives of the course. Attendance may mean more students participate and are involved in class activities. In PRS studies, attendance was identified as an important factor by students in classes that used PRS devices. In such cases, there was a positive attitude towards PRS supported classes and systems (Mula & Kavanagh, 2009). Motivation is a factor that encourages students to attend class or participate, and that factor might consist of the need to learn or the use of a clicker (Pelton & Francis Pelton, 2008). Therefore, students need to be motivated to attend class and PRS is considered to be an appropriate tool that could increase attendance in the classroom.

Traditional methods of using an attendance sheet and the response to PRS questions were both used to record attendance in PRS classes in one study (Gauci *et al.*, 2009). Traditional attendance sheets may be used because some types of PRS does not allow the lecturer to record the answers as an indicator of attendance. However, the PRS method of recording attendance is easier than using attendance sheets. Some types of PRS allow students to record their own attendance directly by entering their enrolment number at the beginning of the class.

7.7. Student attention

Research shows that students' attention spans last no longer than 15 to 20 minutes (D'Inverno, Davis & White, 2003). From an educational perspective, capturing students' attention might be the first step towards successful learning. In teaching any subject, teachers must first capture their students' attention before they can make memories or experience learning (Willis, 2005). The students' attention is defined as the effort devoted to concentrate or focus on a new or current course topic or lesson. This may be improved by using new tools

such as PRS. For example, in accounting classes, motivation was one of the main benefits of using PRS by encouraging the students to pay attention (Mula & Kavanagh, 2009). Furthermore, student involvement makes the class more interesting, and moves students away from rote learning and memorisation, toward a richer understanding of accounting and its place in the world (Mula & Kavanagh, 2009). These observations are based on the fact that students need motivation to pay attention to the content and to be interested in what is occurring in the educational environment. Without these conditions, it might be difficult to secure the students' attention for more than 15 to 20 minutes. Students' attention is defined in PRS studies as paying more attention in the classroom with the use of PRS.

Students' attention can be evaluated by using a questionnaire or an observation method. FitzPatrick, Finn and Campisi (2011) and Nosek et al. (2006) successfully used a combination of questionnaires and observation to measure the level of attention in the PRS class compared with a class without PRS. Therefore, these methods are considered an appropriate way to measure students' attention.

8. The relationships and overlaps between terms

The literature around PRS focuses on the use of the device and how it might improve the learning environment. In order to create high-quality studies in PRS, the related terms in these studies were defined and the relationships and overlaps between these terms should next be clarified. Therefore, this section presents the relationships and the overlaps between the terms.

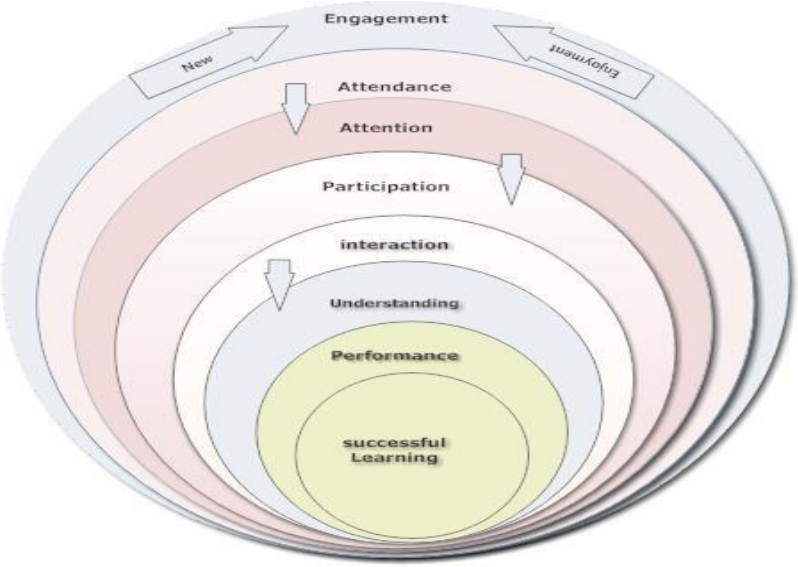

Figure 3 The relationships and overlaps between terms

The above circle diagram has been designed to show the relationship, interplay and overlap between the terms. It can be seen that the diagram is divided into levels, the basis of which is engagement and the main goal for all these terms is successful learning. The main goal can be attained by achieving the terms in turn.

Educationally, it is believed that engaging students in interesting tasks or problem solving tasks, where students feel they learn or solve a problem, may lead to deeper learning (Floyd, Harrington & Santiago, 2009; Stagg & Lane, 2010). This is supported by Dewey who thought providing problem solving tasks in social contexts or in the real world leads to increased engagement and, thereafter, deeper learning (cited in Saltmarsh, 2008); Marton and Saljo, 1972). This can move students from being consumers of knowledge to producers. Similarly Vygotsky's concept of engagement in social contexts suggests students interact to construct their understanding (Vygotsky, 1978a). According to Gachago et al. (2011), engagement has three levels, with attention as the first level, participation as the second and finally understanding, or deep understanding, as the third level. Subsequently, students may have high academic performance and achievement

after understanding the concepts fully. However, students need motivation to be engaged in PRS classes, which comes from their need to learn and the enjoyment of using PRS (Figure 3). Motivation is the factor that encourages students to participate, whether that factor consists of the need to learn or the use of a clicker (Pelton & Francis Pelton, 2008), with engagement encouraging the students to attend class.

Morling et al (2008) reported that a high level of attendance means the students are engaged. Therefore, high levels of engagement will lead students to attend classes and, thereafter, they will feel comfortable participating; however, before that, they need to pay more attention. Therefore, attendance, attention and participation are levels that occur respectively after engagement (Figure 3). Nonetheless, some studies report that attendance is the first effect of engagement, followed by attention and participation, and thus they were presented in the same level. That might be true, but by looking at each factor we see they are all linked to engagement. In addition, attendance does not simply equate to attention or participation. In other words, not every student that attends class will pay attention or participate; furthermore, they may pay attention to the lesson, but not participate.

Moreover, participation can enhance the learning experience by encouraging interaction between student and student, student and lecturer, and student and PRS. Students may feel more comfortable with interacting with the lecturer, students and PRS devices, especially after participation, and students may become more confident. Additionally, students might learn more by questioning their peers or discussing their answers. Interacting with lecturers to receive feedback about their answers, or engaging with other students, may give students

more confidence to participate and present their opinions. Moreover, Pelton and Pelton (2008) reported that participation encourages students who pay more attention in class, use in-depth thinking and reflection, learn from one another's reasoning and mistakes, evaluate their own misconceptions, perform better on tests, have greater retention and have improved attitudes toward learning.

Understanding is the level that comes after participation and interaction, as learning occurs in the social context. When the teacher asks a question, the students will think more deeply and try to understand the topic in order to answer the questions. In order to answer a question, a student needs to interact with the teacher and his/her peers to state the correct answer and to avoid misconceptions. In most cases, this could lead to a high level of understanding, which is knowledge retention, whether immediate or long-term. Subsequently, students might be able to perform better in class, in which case successful learning will occur, whereby the students may gain high grades, which means students' performance is improved (Stowell & Nelson, 2007).

Consequently, engagement seems a basic factor in the successful use of PRS because all the other elements rely on engagement. According to social constructionist learning theory, engagement can lead to increased attendance, direct student attention, increased student participation and improving student performance. Essentially, students need to be engaged in learning to encourage them to attend class. Engagement consists of stimulating the students' awareness periodically throughout the lecture by using clickers to ask questions (Patry, 2009). Therefore, the first step is engagement and then attendance, attention, participation, interaction, understanding, student performance or achievement, respectively. Without achieving any one of these stages, the

learning process may be negatively affected and, in effect, sabotaged. Liu (2008) reported that successful learning occurs with the availability of engagement, attendance, attention, participation and interaction. Therefore, successful learning will need to reinforce these terms by passing through each described level.

9. The motivation behind the use of the PRS in education

From an education perspective learning occurs when there is dialogue or interaction between student, instructor and the educational environment (Agbatogun, 2013; Vygotsky, 1978b). In the traditional learning environment, transmissive methods were commonly used for learning where dialogue or interaction were absent (Kennedy & Cutts, 2005; Simpson & Oliver, 2007). In the traditional lecture, where a student acts as listener, s/he learns little or possibly nothing of the information, due to the transmissive method (Crouch & Mazur, 2001).

Introducing constructionist methods, which engage interaction between teachers and learners through using PRS mostly lead to an improvement in the learning process. Many studies refer to a lack in interaction between learners and instructors and between learners in the traditional lecture (Sharples, 2000), which are set in behaviourist learning cultures that are commonly found in Saudi Universities. For the instructor to have an effective teaching method and achieve the objectives of the learning, s/he may need to make learning a social interaction with dialogue between instructor and learner (Agbatogun, 2013). Learning with a lack of interaction may not prove effective for the learner as this does not prompt the learner to approach higher levels of thinking, such as critical thinking (Robinson & King, 2009).

In order to change the passive role of the learner within the traditional learning environment, teachers need to adopt more interactive methods whereby the learner is involved in learning during the class time (Kennedy & Cutts, 2005; Scanlon & Issroff, 2005). Additionally, to promote interaction, the instructor needs to adopt an approach which involves peer discussion, practical exercises and demonstrations (Yoder & Hochevar, 2005). Using technology might be the modern approach to promote interaction, however technology must be used purposefully, not just for its own sake. Technology can be efficient when it can successfully achieve the objectives of the education activity and overcome existing difficulties (Puentedura, 2010). Many studies argue that PRS can be a solution for effective teaching and learning, by increasing interaction in the educational environment (D'Inverno, Davis & White, 2003).

Currently in education there is more emphasis in learner-centred than teacher-centred pedagogy. This has changed education to ensure there is more involvement for the learner in the learning process (Milrad, 2003). In this approach learners have more ability to participate in learning with a central role in the learning process, while the teacher acts as supervisor for the learning process and facilitates the learning activities (Milrad, 2003). In the traditional class format, teachers might be able to engage students through asking questions with the expectation that learners will voluntarily participate by raising their hand. Another approach is using green and red cards to refer to the right or wrong answers. Although in both approaches fewer students may be engaged, but learners can be identified because they need to show their answers in front of other learners (Caldwell, 2007). Generally, the participation from students in the traditional class is low due to the role assigned to them as passive receivers of knowledge – thus they are restricted by the rules of the traditional class. In such

educational environments the majority of students do not pay attention, with only a few students actively participating in the learning process (Kennedy & Cutts, 2005).

The teacher used another method known as “instructive questioning” (Agbatogun, 2013), as an approach to encourage interaction; nonetheless, large numbers of students in a class may hinder this approach. Students do not prefer to answer or talk in a classes with a large number of students (Agbatogun, 2013). Therefore, the majority of the students prefer to keep silent when the instructor asks a question and few students participate in such activities. Normally the same students volunteer to answer questions in every class (Caldwell, 2007). In using the traditional method (show of hands, short quizzes and flashcards) to actively engage students in the learning activity, normally the “confident students and out-spoken students” participate the most (Agbatogun, 2013).

Many recommendations were made in the previous studies to promote engagement and interaction in the classroom using PRS and to make time for discussion (Agbatogun, 2013; Reay *et al.*, 2005). Caldwell (2007) concludes that using PRS is a successful approach to increase engagement and interaction and is vital for learning development. King and Robinson (2009) through their review of technology use in the classroom, found researchers and educators believed that using PRS helps students to achieve the full benefits of learning activities and allows progression to the learner-centred approach. A study at Nanyang Technological University, Singapore, for undergraduate students studying in different faculties (Engineering, Humanities and Social Sciences, and Biological Sciences) showed that students felt more engaged and were more likely to participate in PRS sessions than those in a traditional class (Laxman, 2011).

One of the main purposes for using the PRS in education is to give learners a voice and to encourage them to think critically in the educational environment. Furthermore, educators use PRS as a tool to increase student confidence in the learning environment. By participating in the learning activity, students can see their answers and compare them to other students who may have chosen the wrong answers. Thus a student can realise there are other students who have wrong answers, increasing their confidence. PRS can create more dynamic learning and teaching environments, where students are engaged and think more quickly to solve a problem (Stuart, Brown & Draper, 2004).

Moreover, using PRS as a group activity has been effective for instructors because the feedback from PRS gives an overview of teacher performance during lectures and measures the students' understanding of the lesson (Agbatogun, 2013; Daniel & Tivener, 2016). Teachers need quick feedback to improve the pattern of teaching, but the learners also need feedback about their learning to improve their approach to learning. This instant feedback will help both teachers and learners take quick action to improve their performance. However, planning for PRS activities, such as timing and asking suitable questions related to the content, may help to assess student and teacher performance. In the traditional method, students often wait more time to obtain feedback about their performance, usually through summative assessment. Similarly, the teacher in traditional methods (in exams or short quizzes) may take time and effort with grading to provide accurate performance information. Using the traditional method may have negative effects on the learning process as it does not allow quick responses (Kennedy & Cutts, 2005). An example of this is a study conducted to see the effects of delayed feedback on the learning outcomes of 95 undergraduate students on a psychology course (Dihoff *et al.*, 2004). The

researchers concluded that immediate feedback increases knowledge retention, prevents error repetition, and increases confidence, in direct contrast to delayed feedback.

Indeed, many studies show that using PRS provides fast feedback both for the instructor about the students' understanding of the content of the lesson, and for the students, who are motivated to interact more in discussions (Fan & van den, 2006; Russell, 2008; Watfa & Audi, 2017). Moreover, a study by Beatty (2004) found that using PRS helps students to find the weaknesses and limitations in their performances and highlights any misunderstanding. This advantage of PRS allows students to find any weakness at an early stage after which they can ask for help from the instructor or other students, allowing them to improve (Egelandsdal & Krumsvik, 2017). This process will help students to reduce their percentage of wrong answers and increase their percentage of correct answers (Agbatogun, 2013).

In the traditional classroom, teachers can struggle to encourage students to participate in learning through answering questions, especially in large groups. In the previous format of learning students avoid answering the teacher‘s questions because they wish to avoid the embarrassment of giving the wrong answers. Therefore, they prefer to wait to hear the answer from the teacher or from other students (Kennedy & Cutts, 2005). Moreover, the PRS encourages students to answer the teacher's questions anonymously within the allotted time. Kennedy and Cutts (2005) reported that using the PRS helps to manage and reduce students' frustration while answering questions in the educational environment. King and Joshi (2008) reported that students gain more confidence through answering the instructor multiple times during the lecture.

Many universities around the world are equipped with technology intended to improve learning. However, the majority of technologies provided in lectures are used solely by lecturers. Therefore, these technologies perpetuate a teacher-centred approach to education (Agbatogun, 2013). Many of these technologies were not successfully implemented because of high costs, lack of access for students to use, and lack of teacher skills in using the technology to enhance pedagogy. Additionally, affordances within some technologies do not provide tools for measuring students' understanding or offering quick feedback (Lymn & Mostyn, 2010). Nevertheless, PRS use is not always successful because of technical problems associated with posing questions, receiving answers and presenting results. These technical issues can waste lecturers' time in solving them, when they should be teaching the content of the lecture (Beatty *et al.*, 2006). These technical issues can be a distraction during the learning process and could reduce the level of interaction between individuals.

9.1. Using PRS pedagogically for effective learning

Essentially, educational technology does not work effectively without a suitable approach. Therefore the ways instructors use technology in the educational environment are fundamental in improving learning (Judson & Sawada, 2006; McKnight *et al.*, 2016). There are many suitable ways of using PRS, as suggested in many studies before; however, there is no unanimity about the most suitable way to use PRS to enhance learning. The majority of strategies for using PRS apply the constructionist learning theory by encouraging more interaction between individuals in the classroom. One suggestion for instructors was to use PRS to promote learning by not offering students high grades based on their answers (Eastman, 2007). Thus, using PRS without grades may encourage students to use it freely by participating in learning rather than thinking about their

marks. Indeed, the students prefer to promote interaction and communication rather than thinking about marks (Agbatogun, 2013). A review by Beatty (2004) suggested the teachers should pay more attention to using PRS pedagogically, as increasing interaction will lead to improve learning and help students to construct their understanding (Vygotsky, 1978b). Additionally, the number of questions is important for the success of PRS activities as these can enhance or detract from learning. Eastman suggested that the optimum number of questions that increase interaction and communication is between two to three questions (Eastman, 2007), although another study suggested students will be engaged best if the number of questions is between three to five questions (Knight, Wise & Sieke, 2016). Most important to measuring the students' understanding of the content is the quality of the questions and how the questions are formulated. Eastman (2007) emphasises that the questions should not be limited to one style, for example, Yes or No. There should be a variety of question formats to make the activity more interesting and increase student attention.

Asking a reasonable number of questions will allow the teacher to adopt the proposed role Vygotsky espoused in the social constructionist learning theory (Weegar & Pacis, 2012). Therefore, the lecturer will be guiding the activity and encouraging students to interact and learn through questioning. However, the questions should be appropriate to the lesson to increase the possibility for interaction and learning, otherwise they will become a distraction for the students. Agbatogun (2013) suggested that the teacher should ask three questions during class with escalating levels of difficulty. The first question should be the simplest question to help students warm up and increase their confidence at the beginning of the lecture. During the first use of the PRS in a lecture the majority of students will answer, therefore it is worthwhile to give limited time for peer discussion so

they gain more confidence. The second question should be more difficult than the previous one, where the teacher allows students to respond and then discuss their answers before showing the correct answer. In this level students will start to learn through discussion, interaction and sharing knowledge, an ideal supported by social constructionism. Vygotsky argued learning is “co-constructed” with other individuals through language and cultural interchange (Vygotsky, 1978a). The final question should be the most difficult, with the aim of assessing the students’ overall understanding of the content. Students who answer the second question correctly will most likely answer the third question correctly (Reay *et al.*, 2005), but this may not be consistent where students lose attention during the lecture. Additionally, Vygotsky (1978a) believed there is a level of development of learning where the learner is able to solve problems independently. Beyond this level is another level where learners are able to share knowledge with peers and teachers as a potential development determined by the collaboration between student, peers and teachers. This level is called the “zone of proximal development” ZPD (Vygotsky, 1978b), wherein with guidance and cooperation with the instructor and students, learners can construct their knowledge.

Vygotsky’s concept was used to understand the overlapping between external and internal development. The external impacts of the environment are teachers, peers and the PRS questions. It is fundamental that the PRS questions are clear and understandable for the student. The number of options for the PRS questions should be between three and five. Moreover, the guidance from the teacher and the collaboration between peers is important to construct the students’ knowledge with the support of the PRS questions.

Many recommendations about using the PRS in the classroom exist in the current literature. For example, Martyn (2007) has evaluated the use of PRS in terms of improving outcomes with 92 students in four sections of introductory computer information systems classes, aged between 18 to 22 years, and the following advice on how to use the PRS emerged from this investigation:

- Allowing discussion between the learners with sufficient time either before or after showing the result of a question, as it allows them to share knowledge.
- Asking a reasonable number of questions covering the content of the lecture at the right time to allow learners to interact and construct understanding.
- Allowing enough time for answering the questions.
- Locate the question at a suitable position on the screen to make it easier for students to read it.
- Testing the system before the lecture to avoid any technical problem that may effect asking the questions, receiving the answers and showing the results.
- Provide information for the learner about how to use PRS on the blackboard or on a website to understand how the system works.
- Using a timer is preferable as students may become more excited participants in the learning.

However, with this advice the purposes and goals of using PRS should be taken into consideration as some of them may not be appropriate in all situations, for example, using PRS for conferences or for entertainment. The aim of improving learning through increasing interaction between students and lecturers can be achieved through these recommendations, especially allowing time for discussion. This corresponds with social constructionist learning theory and its aim for improving learning.

Planning for the PRS activity is important and essential for the successful implementation of PRS (Agbatogun, 2013). Caldwell (2007) presented some recommendations for implementing PRS, suggesting that the teacher needs to know the purpose of implementing such technology in his/her classroom. With a clear goal s/he can implement it successfully and will help improve the affordance of the technology. Additionally, the teacher needs to be able to overcome the most common issues with using PRS. For example, having sufficient keypads for every student is important, and each handset needs to be checked before the class starts. Moreover, teachers need to read about PRS and how it works and they may be advised to observe other users to see the best uses of the system. This step will increase the perceived affordance for PRS and it may lead to more purposeful use of the technology. The first time using PRS may be difficult as it may take more time and effort to prepare for the lecture since the technology is unfamiliar. Generally, the recommendations emphasise the social context and the importance of dialogue between individuals. The recommendations consider prior experience for both students and the instructor in the use of PRS for learning, which aligns with constructionist views of learning environments. Clements (1997), states:

> *"Constructivist teachers consider the prior knowledge of their learners and provide learning environments that exploit inconsistencies between learners' current knowledge and their new experiences."* P.11

Therefore, the recommendations focus on the activity as a social learning activity with prior experience for the users as a means for development and constructing learning.

9.2. Using PRS pedagogically

There are different goals for using PRS based on the users' needs, therefore the successful use of PRS is directly related to the user's objective and ability to achieve this objective (Bruff, 2007). Common methods for using PRS in education have appeared in the literature. These methods include:

9.2.1. Using PRS as assessment tool

PRS questions have been used to assess students' understanding of the content during lectures. Moreover, PRS questions can be used for the final exam as the student will discuss them beforehand and have an idea about how the exam looks. Additionally, the students can measure their understating and have more clarification from other students or from the instructor (Draper & Brown, 2004; Kennedy & Cutts, 2005). Therefore, PRS can be used as a form of formative as well as summative assessment method to test students' knowledge about the course content and offer them instant and accurate feedback (Agbatogun, 2013; Heinerichs, Pazzaglia & Gilboy, 2016).

Using PRS as a formative assessment tool can increase students' retention and increase their engagement (Bruff, 2012). These methods of using PRS will create a learning community in the classroom regardless of the number of the students present. Additionally, using PRS as an assessment tool will provide instructors with important data about their teaching style and indicate areas for improvement. The feedback will help both students and instructors to construct their learning. However, the quality of the questions and the anonymity of answering may affect the students' answers and the time required for asking questions. Furthermore, answering questions may affect the reliability of students' answers (Caldwell, 2007). Therefore, the strategy for using PRS may effect its effectiveness as a tool for assessment. This is especially true if the question is not accurate and does

not measure what it was intended to measure, or if the answers reveal student identities.

Using PRS as a summative assessment tool might not work effectively. Normally a final exam will include many questions and can measure many concepts and skills. The PRS might not be effective to cover all of these aspects. The time and purpose of these exams might not fit with the use of PRS. Hancock (2010) disagreed with using PRS for summative assessment as it is a critical method for students and does not improve their grades. Additionally, there is concern about the reliability of the score as the students may answer the questions in the same way when seated next to each other, which might be an indication that they have copied the answers from each other.

9.2.2. Using PRS as peer instruction

PRS has the greatest potential to promote peer instruction above other, similar technologies. Students can be engaged during the activity as peer instruction methods encourage students to apply concepts and express their understanding to improve their learning (Crouch & Mazur, 2001). This method may offer students the ability to share knowledge, ask questions and correct their responses. Additionally, this method is supported by social constructivist learning theory (Weegar & Pacis, 2012). In contrast, teachers in traditional lectures pose questions individually, allowing only a few students to participate and mostly without interaction. Normally the strategy for peer instruction with PRS is through asking questions with students answering in groups or as individuals. Then the teacher has the choice either to discuss the answer before showing the results, or after showing the answers. Showing the answers gives the teacher and the students opportunities to discuss them, especially if there are noticeable differences in the percentages of answers. Having peer discussion before or after

showing the results gives students an opportunity to choose more correct answers then and in the future (Kennedy & Cutts, 2005).

Nevertheless, the students need to be prepared for the lecture otherwise they will not be able to participate fully in peer instruction (Crouch & Mazur, 2001). Moreover, the behaviour of the students and their motivation to participate in the activity is important, or the student may not engage and this method will not be effective for improving learning (Nicol & Boyle, 2003). Therefore, learners need to be convinced and motivated to participate. Using peer instruction with PRS can be time consuming and may lead to a loss of control; however, the teacher needs to plan for the activity and allow sufficient time for it. In the current study this strategy was used by one lecturer to improve peer instruction through using PRS as a method to construct students' understanding.

9.2.3. Using PRS as a group discussion method

The peer discussion can be expanded to engage all students in the classroom to promote wider discussion. In group discussions, the instructor encourages all students to participate through sharing their opinions about the content or asking questions. The motivation for the group discussion is within the PRS questions during a PRS activity. This strategy corresponds with social constructivism as the conceptual understanding will increase through the PRS activity because the student will construct his/her understanding of the concepts and their inter-relationship by participating in the activity (Nicol & Boyle, 2003). Social constructivism emphasises that learning in a social context is mediated between individuals and they construct their understanding of the concepts through dialogue with each other (Lave & Wenger, 1991). To ensure the efficacy of the system, the teacher needs to carefully design the questions to make sure they will motivate the students to engage in discussion. This type of discussion will

help students to contribute to the learning process and discuss any difficulties they have related to the course content (Kennedy & Cutts, 2005). Furthermore, not allowing dialogue between learners in the PRS activity may lead to failure in implementing or achieving the usefulness of it (Duncan, 2008).

Applying this strategy could be time consuming if the teacher is not planning specifically for the activity, as s/he needs to prepare the questions and choose the right time to ask them, as well as managing the duration of the discussion. Additionally, it might be difficult to control the activity, especially with a large number of students, because the time is limited and many students may be motivated to engage in the learning. Moreover, with large classes it might not be possible for all students to participate directly in the discussion.

Despite the possibility for improvement in learning through class discussion there are some aspects that remain unclear, for example, their experience and which aspect of the educational environment improves their learning (Nicol & Boyle, 2003). Although it has been shown in the literature that learning occurs through dialogue between learners, there is no clear view which method is more effective in improving learning. For example, teacher to single student discussion, peer discussion the whole class discussion. Moreover, the number of students in the PRS activity may lead to loss of control if the teacher has not planned adequately. In this study, to increase interaction and encourage all the students to engage in the learning group, discussion was used in all lectures, while peer instruction was used by one lecturer in one subject.

9.2.4. Using PRS to increase student attention and get them engaged

At the beginning of any learning process students need to be engaged or

warmed up by asking them some questions about the topic of the lecture from their experience (Agbatogun, 2013). This will help students to be ready for the learning process before the instructor starts teaching. This strategy was used by seven lecturers in this study to encourage students to engage from the outset of the lecture.

Additionally, PRS can be used as a management tool in the classroom. At the beginning of any lecture the students keep moving, asking, talking or preparing notes for the new lecture. Using PRS to ask questions at the beginning will encourage students to be ready for the lecture quicker than in traditional lectures, and motivate them to pay more attention (Simpson & Oliver, 2007). Moreover, the strategy for using PRS by asking questions helps students to increase their attention and engagement during the learning activity, especially if the teacher allows dialogue between the learners and teacher involved in this activity (Jonassen & Rohrer-Murphy, 1999; Nicol & Boyle, 2003). Therefore, one advantage of using PRS as a strategy for learning is to increase engagement and attention, and thereby learning, by asking questions. Beatty (2004) justified the increase of engagement and attention with PRS thus:

> "*Develop a more solid, integrated, useful understanding of concepts and their interrelationships and applicability. A concerted focus on understanding rather than recall, and on reasoning rather than answers*" (p.5).

Therefore, asking questions where every student has their own device enables them to express their understanding in complete anonymity. This can motivate students to be more engaged and pay more attention (Hunsu, Adesope & Bayly, 2016; Martyn, 2007). Nevertheless, there are some disadvantages in the use of PRS to increase engagement and attention. For example, technical problems can

be distracting (Draper, Cargill & Cutts, 2002). Moreover, asking many questionsduring lectures could be a distraction for some learners, so lecturers needs to plan carefully to ensure the PRS activity is effective in improving learning (Martyn, 2007). The quality of the questions can also be an obstacle for students to become engaged in the activity (Duncan, 2008). In other words, students will not be able to pay attention if the questions are too difficult or ambiguous.

9.3. Best practice for PRS

The PRS has been used in education for many reasons, depending on the objectives of the lecture (Zhu, 2007). Furthermore, it is a relatively easy tool to use for teaching and learning. Technical problems can create the greatest difficulties because they can affect the students' attitude toward this technology and cause a lot of distractions (Draper, Cargill & Cutts, 2002; Walklet *et al.*, 2016). The user can encounter several types of problems during the lectures (Zhu, 2007). Mainly, students face problems such as connecting their devices to the receiver, finding a signal, and the amount of time taken to distribute, set-up, and collect the PRS devices (Walklet *et al.*, 2016). At the beginning of the lecture, students sometimes struggle to find the signal and this can be frustrating. Further, instructors normally struggle with software issues, particularly when attempting to show student responses or recording students' answers. However, although the PRS is easy to use and may not need training to be used, it is essential for the teacher to have experience of and training in using Microsoft Office. This experience and training would be helpful to remove any technical issues.

The teacher should make sure the PRS software is compatible with the operating system in the computer used for the class and that the software is installed ahead of time, helping to reduce the possibility of technical issues. Conversely, students

do not need to have training (Zhu, 2007), instead they can learn through usingPRS in the first lectures, or they may able to find technical support at the university to solve any issue. The cost of the PRS is the second common challenge for the students (Zhu, 2007). The students see the cost of PRS remotes as problematic because they are expected to buy or borrow their own remotes for the duration of the course and this can be quite expensive. Generally, the prices for the remotes ranges from between 10$ to 30$. The difficulty of the cost is exacerbated if the students do not see the efficiency of using this technology. Therefore, students need to see a justification for buying this technology remote. For example, they will feel it is not worth to buy PRS remote for just one module or two lectures. Therefore, it is important for the students to use a PRS remote consistently and in an effective way to make it worth the expense.

The questions might be a particular challenge for the students when using the PRS. Preparing effective questions will enable students to make connections between what they are doing and their learning objectives, so they need to be clearly presented (Beatty *et al.*, 2006). Different questions will allow different responses based on the purpose of those questions. Questions can be used to assess the basic level of knowledge 'recall' or they might be used to encourage higher level analysis, synthesis or evaluation. Such questions require critical thinking and judgment. Fundamentally, generating an inappropriate question or an ambiguous question may negatively affect the purpose for using these questions.

9.4. Quality of PRS questions

The purpose of the questions is therefore reliant on the quality of the questions. Teachers may therefore need to learn techniques for writing effective questions. Caldwell (2007) states that "*Typically, ARS questions are written before class as*

a part of preparing lecture notes or lesson plans" (p10). Therefore, adequate and careful preparation for the lecture is an important factor in the successful formulation of high quality questions. Additionally, qualitative questions are much more effective than quantitative questions, because lecturers can gain a clearer insight into students' perceptions. Practical suggestions from Beekes (2006) and Draper and Brown (2002)for writing effective questions include the following:

- Distinguish between students' knowledge of jargon and their understanding of concepts (Beekes, 2006).
- Create wrong answers (distracters) that seem very logical or plausible to students to prevent them from easily eliminating wrong answers.
- Limit the number of answer choices to five or less.
- Considering include "*I don't know*" as an answer choice to prevent students from guessing.
- Essentially there are different concepts when it comes to the quality of the questions; however, the main concept is creating questions that measure what was intended to be measured, or for a specific pedagogical purpose.

10. The usefulness of PRS in education

The potential usefulness of PRS in education can be seen in an instructor's performance, in terms of how effectively they deliver information to students. Moreover, the literature review suggests PRS can have a positive impact on students' learning(Walklet *et al.*, 2016). The usefulness of PRS cannot be achieved without the effective use of the system (Albon & Jewels, 2007; Simpson & Oliver, 2007). Many studies have shown that using PRS helps students to be active during the learning process in contrast to the traditional lecture, where

students are normally passive (Caldwell, 2007; Draper, Cargill & Cutts, 2002; Martyn, 2007). In a similar study Johnson and Meckelborg (2009) found using PRS encouraged students (184 students enrolled in an education assessment course, evaluated using questionnaire) to be more active during the learning process.

Nevertheless, this is not always the case as distractions are possible during the PRS learning activity. There are different types of PRS, for example, in mobile phones, computers, laptops, iPads and actual PRS. Many studies have found using PRS in media other than the PRS units themselves are a distraction for the students and for the learning process (Duncan, Hoekstra & Wilcox, 2012; Stowell, 2015). Therefore, using online devices are going to increase the possibility of distractions for students, since when these devices are linked to the internet students might start to browse websites, Facebook or other social networks.

This may have a negative impact on student engagement and their attention. Additionally, some aspects have not been considered, for example the technical issues, the strategy for using PRS and other individuals' behaviour during the learning process. These aspects may reduce engagement and attention for students and it will affect the ability of students to construct their own learning. In the following sections, some pedagogical benefits of the PRS will be described.

10.1. Increasing interaction

Interaction is a vital factor for the construction of knowledge between instructor and students and between students and the course content. Essentially, interactivity helps support a successful learning process through the instructor, encouraging students to engage actively in the learning activity (Agbatogun, 2013). Introducing PRS has presented opportunities for more interaction in the educational environment between students and lecturers regardless of the

number of the students in the class (Daniel & Tivener, 2016; Meedzan & Fisher, 2009). Generally, the strategy for using PRS by asking questions helps students to engage in the learning activity, especially if the lecturer allows for dialogue (Jonassen & Rohrer-Murphy, 1999; Nicol & Boyle, 2003). Using PRS to increase interaction corresponds to social constructionism, where conceptual understanding might increase through the PRS activity. Students may be encouraged to construct their understanding of the concepts and their inter-relationships (Nicol & Boyle, 2003; Vygotsky, 1978a).

The role of the lecturer will change from simply delivering the information to guiding the activity (Vygotsky, 1978a) while asking questions and giving feedback to students during the PRS activity. However, if the lecturer uses the system only at the beginning or at the end of their lectures, this may not support social constructionist learning. The students will only have minimal chances to interact with other students and the lecturer. The students will be more able to engage in the learning activity by answering questions and discussing answers with other students. Using PRS to promote interactions has increased students participation in the educational environment, leading to improved student achievement (Blood & Neel, 2008). Nevertheless, McCabe and Lucas (2003) reported that improvement in interactivity using PRS only occurs when it is used effectively. They gave examples of an effective usage by presenting short, five-item quizzes during class time to encourage peer discussion or group discussion between students. The usefulness of increasing interactivity through PRS was reported in the study by Sharma, Khachan, Chan and O'Byrne (2005). This research group used questionnaires to measure the efficacy of using PRS to increase interactivity for 138 undergraduate students. The majority of the students found using PRS was an effective way to increase interactivity and motivate them to engage in

learning activities. An example of ineffective usage was given as using PRS without a prior plan for the activity, which led to a failure in improving interaction (Duncan, 2008). Therefore, increasing interaction is a vital element to help students to construct their knowledge, but this needs to be carefully planned within a clear strategy. Nevertheless, using PRS superficially for lecturers to pose questions and students to respond, without enabling interaction or discussion, does not help to improve learning. Learning effectively occurs in a social context where dialogue and knowledge sharing are important (Vygotsky, 1978a).

10.2. Increasing participation for students

Many students experience anxiety when responding to questions where their identity is exposed to members of their peer group. Using PRS has helped students to overcome this difficulty as they can answer the teacher's questions anonymously (Reay *et al.*, 2005; Stuart, Brown & Draper, 2004). In order to improve the learning activity the style of learning should move from transmissive learning to constructionist learning (Nicol & Boyle, 2003). Technology supported constructivist learning environments emphasise collaboration and involvement in learning from both students and the teacher to improve learning (Jonassen, 1994), instead of abstracting the knowledge and trying to deliver it solely through speech. Additionally, Dewey (Ültanir, 2012) rejected the notion of the traditional class, based on repetition and memorisation, and recommends allowing more involvement for students during the learning process to increase their experience and give more opportunities for them to construct their own learning (Neubert, 2003). Responding to questions from PRS has encouraged students to express their understanding of the content, whether wrong or right, as they answer anonymously.

Furthermore, the impact of PRS on students' participation has positively changed instructor behaviour toward technology in teaching, through its capability to motivate students to participate during lectures (Caldwell, 2007). A study by Reay et al. (2005) investigated incorporating problem solving questions into PRS questions. 140 undergraduate students reported that using PRS made them more confident to participate and answer the instructor's questions within traditional lectures.

Moreover, in a study at Nottingham University for 33 students enrolled in a pharmacology course, Lymn and Mostyn (2010) confirmed that they found around 81.5% of the students were encouraged to answer 127 questions during 8 lectures. Fan and Blink (2006) confirmed that PRS has increased student participation at an undergraduate level during an introductory computer programming course, in comparison to traditional lectures. Additionally, Kennedy and Cutts (2005) agree that students who use PRS more frequently achieve a higher percentage of correct answers and better performance in comparison to infrequent student users. Student responses increase when they are aware of the anonymity of their answers in PRS in comparison to the traditional lecture (Shneiderman *et al.*, 1995). Indeed, one of the main reasons for not participating in a traditional classroom is the anxiety of publicly making mistakes or giving wrong answers (Beekes, 2006). Therefore, the majority of the students in the traditional lecture prefer not to participate to avoid the risk of being seen giving an incorrect answer.

Culture offers tools such as language and other materials to help individuals to learn and construct meaning (Vygotsky, 1978b). Language is the most important tool to construct meaning and allows interchange during the learning process.

Nevertheless, this was not considered in the majority of PRS studies. In many Higher Education institutions around the world, learning is conducted in English despite the English language not being the first language for the majority of students. This might be a hindrance for students to participate in learning and creates a challenge for clear negotiation between individuals and social knowledge (Karagiorgi & Symeou, 2005). In recent years, the learning policies in universities in Saudi Arabia have shifted toward teaching students in English, especially in medical faculties. Therefore, those using PRS technology must consider other cultural aspects that may negatively effect the learning process. The literature reveals a few studies conducted in using PRS with non-native speaking English learners who were taught in English. Rodriguez and Shepard (2013) conducted a study with 15 students enrolled in a basic technology course offered by the Family University Program (FAMU). All were native Spanish speakers taught in English. The findings revealed the students with an intermediate level of English skills found the PRS useful for them to learn; however, the students with a lower language skill level found PRS less useful, as some terms were difficult for them, and they could not understand the whole question. Additionally, in a study in Nigeria with 99 students from three primary schools learning in English, showed that PRS was an effective strategy for learning English because it enriched their understanding of new terms (Agbatogun, 2014).

This was confirmed in another study at the University of Science and Technology in Taiwan with 20 Taiwanese students learning English as a second language. The study showed the students' English language skills improved as result of using PRS to increase interaction (Hung, 2017). Therefore, PRS might be a useful tool to improve English language learning.

The understanding of the new terms may occur during interaction with other learners or with teachers in a social context. This perception refers to the social constructionist theory where culture and language are the mediating tools for learning (Vygotsky, 1978a). Moreover, the quality or clarity of the PRS questions might discourage students from engaging in the learning activity (Draper, Cargill & Cutts, 2002). Therefore, there are many aspects to be considered when using PRS to make the activity effective for the student.

10.3. Increasing attention and engagement

Attention is a difficult objective to achieve, and many educators struggle to sustain students' attention and keep them focused during the teaching process (Lantz, 2010). Furthermore, most students experience difficulty in focusing for more than 20 to 30 minutes at a time (Agbatogun, 2013). Many studies show that during the learning process students reach a point where they lose attention or interest in a lecture (D'Inverno, Davis & White, 2003; McLaughlin & Mandin, 2001). In a PRS lecture, students concentrate more, listening to all the information, enabling them to engage in the learning activity and to interact with other individuals, helping them to choose the right answer and construct knowledge (Bruff, 2007; Simpson & Oliver, 2007). Additionally, Roush and Song (2011) provide evidence that using PRS can increase students' attention. Their study was conducted with 99 Spanish students in a secondary school, using mixed methods (questionnaires and interviews).

The strategy for using PRS to present questions to students helps learners to increase their attention and engagement during the learning activity, especially if

the lecturer encourages dialogue (Jonassen & Rohrer-Murphy, 1999; Nicol & Boyle, 2003). Recently, PRS has been used in large classes to teach science through peer instruction and has been shown to increase student engagement and attention (Duncan, Hoekstra &Wilcox, 2012). This is an vital element for the learning process as students will construct their understanding of the concepts when they are engaged in the learning activity and interacting with other individuals (Nicol & Boyle, 2003).

10.4. Active learning

Learning is defined by many researchers as connection or dialogue between learners and instructor and the content of a lesson (Agbatogun, 2013; Draper, Cargill & Cutts, 2002; McCabe & Lucas, 2003). Many researchers have described active learning as a purposeful approach to gain knowledge and skills beyond the traditional 'passive learner' role (Braxton, Milem & Sullivan, 2000; Butler, Phillmann & Smart, 2001). According to Paschal (2002) the purpose of applying active learning is to change the role of students from being listeners in a lesson, taking notes and memorising information to becoming more involved in the learning process through interaction, critical thinking, participating verbally, analysing and understanding concepts during class time (Paschal, 2002).

Perceptions of using PRS were investigated in a high school in Canada with 659 students by Kay, LaSage and Knaack (2010), where it was used to teach biology, business and chemistry. The results of the survey indicated that the majority of the students (55%) felt they were more motivated to actively engage in the learning process than they would without PRS. Additionally, another questionnaire based study by Johnson and Meckelborg (2009) with 184 students showed PRS use increased student engagement. When students are engaged

they are more attentive, leading to better learning outcomes than acting passively in the classroom (Moredich & Moore, 2007).

In the available literature on PRS use in education, there is solid evidence of the effectiveness of using PRS to increase active learning. For example, the findings of a study by Albon and Jewels (2007) for Asian students (completing units in accounting, power engineering, commerce, mathematics, research and writing skills in engineering and business, and information technology) showed that 70% of participants found PRS was an effective tool for their learning while the majority felt PRS had motivated them to actively participate in lectures. Fan and Blink (2006) carried out a study to evaluate the impact of PRS on new engineering students enrolled in an introductory computer programming course. The findings of this study show PRS made students actively engaged.

10.5. Improving learning

The awareness of student understanding of the content, their assimilation of information, and their ability to learn during class is essential if instructors are to successfully determine the next stage in a course. Student understanding can be facilitated by using PRS in learning activities (Reay *et al.*, 2005). Stuart, Brown and Draper (2004) claimed that PRS questions encourage students to think critically through the process of answering targeted questions. The influence of PRS to increase engagement becomes “a precursor to student-directed” learning by motivating students to learn, as when instructors engage students, they start to construct their own knowledge by interacting with instructors, students and the content (Agbatogun, 2013; Caldwell, 2007; Vygotsky, 1978a). Moreover, Havill (2007) argues that using PRS is an effective method for learning, as there is a gap between the time allowed for asking the question and the time allowed for

submitting the answers. During this gap the student needs to think critically and carefully about the answers to construct and schema allowing them to select the right one (Havill, 2007). Beatty (2004) sees this as a process for deeper understanding through using PRS because students need to decide the most suitable answer for a question. This encourages them to think critically and may also prompt them to actively engage with other individuals in the learning environment.

Furthermore, Meedzan and Fisher (2009) conducted a study to examine the satisfaction of 29 nursing students using PRS in a health assessment course. The findings show that the majority of the participants (89%) reported PRS was the perfect technology for them to gauge their understanding of the content during the learning process and improve their learning. Additionally, Fan and Blink (2006) investigated the use of PRS for learning among engineering freshmen studying introductory computer programming, and the result shows the instructor was more able to determine the level of understanding and misunderstanding for the concepts in a lecture. Furthermore, Simpson and Oliver (2007) confirmed that PRS allows students to gauge their understanding during class, something that was previously unavailable to them in a traditional lecture format. Thus, this feature provides an opportunity for students to take more responsibility for their learning and to work harder to construct their understanding.

The majority of PRS studies found that learning was improved through the use of PRS, which encourages the application constructionist strategies. As a student is the centre of the learning activity, when the instructor posts questions, students need to answer or solve these problems (Karagiorgi & Symeou, 2005). According to Vygotsky's concept of the 'zone of proximal development, this tool

can provide a strategy to solve the problem (answering a question) and increase motivation to construct understanding with the guidance of the teacher (Karagiorgi & Symeou, 2005). Therefore the learner will become active, moving from unknown to known concepts. However, not all teachers apply this strategy; some of them prefer to use PRS at the end of class to simply measure students' understanding. For the majority of time PRS will be used in transmissive learning, whereby the instructor will lead the learning activity and students will be receivers for the information. Additionally there are other elements that may negatively affect learning. As was previously discussed, language can be a barrier, and other individuals may become challenges during the activity, especially if they are not motivated.

10.6. Immediate Feedback

In the learning process, it is essential to have an effective method for feedback to create a successful learning activity (Cutts, Carbone & Van Haaster, 2004). When the students answer the questions, accepting or correcting answers provides vital feedback. This is a part of the teacher's role of supervising student learning in social constructionist learning (Vygotsky, 1978a). Based on the feedback students can seek support from the other students and from the teacher in PRS activities (Lantz, 2010). Normally, feedback for students in the traditional lecture occurs a long time after an exam, or even at the end of the term (Lantz, 2010). This process will not help students to learn as it will occur too late to correct any misunderstanding. The introduction of PRS in the classroom has overridden the difficulty of receiving quicker feedback for students as PRS offers immediate and accurate feedback (Bruff, 2007). This has motivated students to improve their learning, construct their own understanding and correct any misunderstandings.

The students' responses are received by PRS and calculated by the software to be presented in a histogram for the students as feedback. The histogram shows the percentages of the answers given by the students, helping teachers to identify the weaknesses and strengths of the students' understanding (Simpson & Oliver, 2007). PRS feedback can help to control the learning process during the class. More importantly, the feedback from the system may help students to measure their understanding and their way of thinking with the possibility to compare their answers against those of other students (Russell, 2008; Simpson & Oliver, 2007). Draper and Brown (2004) conducted a study at Glasgow University on the use of the PRS across the teaching of 8 disciplines (computing, statistic, maths and physics). The findings show using PRS provides immediate feedback for the students about their understanding of the content.

Feedback is an essential element in promoting interaction between learners, as students may be more motivated to ask further questions of the instructor or their fellow students. The PRS activity will not be effective without offering feedback to learners about their understanding. Moreover, allowing discussion between learners and with their lecturer is important to clarify any misunderstandings. The technology itself does not improve learning, rather the strategy for using the technology, which is part of social constructionist theory, does. Using technology helps to improve learning when the lecturer allows discussion, which is encouraged by feedback from PRS (Nicol & Boyle, 2003).

10.7. Increasing Attendance

In traditional lectures with a large number of the students it can be difficult for lecturers to maintain student attendance (Agbatogun, 2013). The findings of many studies indicate that using PRS can increase student attendance (Jackson & Trees, 2003; Wit, 2003). A study by Burnstein and Lederman (2001) found that

assigning marks using PRS could increase student attendance by 15% or more among 40 students at the Illinois Institute of Technology in the USA. Using PRS for learning and teaching would increase student attendance in lectures, thereby reducing student attrition percentages. Thornton (2011) conducted a study at Worcester University in the UK to assess using PRS with 84 students and 2 lecturers. The results show many of the students agreed that the use of this technology crucially and positively influenced their attendance in lectures. Nevertheless, the lecturers in the study differed in their opinions about the reasons student attendance increased (Thornton, 2011).

Mayer et al. (2009) investigated the use of PRS with 237 students who completed an educational psychology course at the University of California. This study was over two terms; in the first term 130 students participated in the study and in the second term 107 students. The findings in this study showed the introduction of PRS increased student attendance in comparison with lectures without PRS. Nonetheless, Roush and Song (2011) reported that students did not report any difference in their attendance with using PRS. One reason for this disparity may be that there was no clear evidence about the increase in students' attendance and the methods used to evaluate, as the majority of the studies were undertaken to evaluate the use of PRS in increasing attendance used quantitative methods over a short duration. Additionally, it is not clear whether the use of the PRS, or the strategy it employed, was the main reason for increased attendance. This issue thus needs further investigation as a means of evaluating the effectiveness of PRS.

11.Using PRS to change the roles for teachers and students

In traditional lectures, students and lecturers act in fixed patterns. Generally, the lecturer intends to deliver information by speaking during the lecture. For their part, students intend to act as receivers of the information from the lecturer, and take notes with little participation or interaction (Zhu, 2007). Introducing PRS may change the role for the lecturer from solely talking and delivering the content to something more interactive (Alfahad, 2012; Caldwell, 2007). When using PRS, the lecturer has additional responsibilities to supervise and assess students' understanding and provide feedback and further explanation. The responses from the students encourage the lecturer to shift to a more active role (Zhu, 2007).

For Vygotsky (1978a) the teacher acts as guide for the activity, helping students to extend their understanding beyond what they could achieve on their own. When responses from students show their lack of understanding, the lecturer acts to intervene, by offering further explanation or adjusting their style of teaching. Student roles also change from passive to active engagement with increased responsibilities toward their understanding (Zhu, 2007). Students might need to better prepare for lectures to be able to answer PRS questions, a reference to the prior experience in Piaget's cognitive constructionist theory. In this approach, the learner requires experience, without which learning can be difficult (Neubert, 2003).

Moreover, during class students need to increase their concentration and think more deeply about the materials if they are to choose the correct answers. Additionally, students may need to justify their answers either to the lecturer or to their colleagues, which can be an important aspect of interaction as they construct their understanding. Thus, the students themselves become an

important component of the lecture, designing their personal learning experiences and constructing their understanding (Zhu, 2007). Nevertheless, not all the students are influenced to enhance their responsibility by using PRS. In other words, some students may prefer the traditional lecture because they consider it to be the teacher's responsibility to teach the class and deliver information. That is, some students may see no need for deeper engagement in the learning process. Therefore, it is important for the lecturer to explain the rationale for implementing PRS to encourage students to adopt a more active role in their own learning. Moreover, it is important for students to understand the nature of their responsibility and involvement in their learning process to make it more meaningful for them. Additionally teachers must adopt a guidance role for the activity by encouraging students to engage, encouraging discussion, and offering feedback or additional explanation to improve understanding (Day and Lloyd, 2007).

Evidence from several studies refers to changes in the roles of students and teachers. These changes occur when using PRS or because of the strategy for implementing this technology. In general, applying social constructivism theory to the implementation of PRS was the main theme in the literature review. Many studies used this theory, mainly by allowing the learner to construct his/her understanding within the learning environment. Activity Theory can be a lens to highlight a strategy to encourage constructivist learning using PRS.

12. The Personal Response System in Saudi Arabia

There has been a huge investment in introducing technology to Higher Education in Saudi Arabia (Alamri, 2011), leading to the introduction of many new technologies to support teaching and learning. One education technology that

has been launched is PRS. The purpose of introducing this technology has been to change the format of learning from passive learning to more interactive learning (Bousbahi, 2014). Changing the format of learning might be an indication of movement from behaviourism to social constructionism by encouraging more interaction in the classroom. The first use for the system in Saudi universities was at KKU in the south of the country (King Khalid University, 2011). There, the system is used for teaching and learning at the Faculty of Medicine. Surprisingly, there was a demand from the students to implement this technology (PRS) to change the atmosphere of the traditional lecture to more interactive learning. According to the university's website, there was support for the idea by the e-Learning Deanship at the university. The university's website shows some advantages of using this technology in learning; however, there was not any evidence of those advantages. The website reported there was an increase in student understanding and the level of interaction between students and lecturers. The PRS was introduced to other universities at the same time, including King Abdulaziz University, Umm Al-Qura University and King Saud University. However, these universities used PRS exclusively for workshops and conferences.

In spring 2014, PRS was introduced to King Saud University for the sole use of female students; the purpose of introducing was to switch from the traditional lecture to more interactive teaching (Bousbahi, 2014). The purpose of the study was to examine the use of PRS as an assessment tool and measure the improvement in the students' learning only females, and was carried out with 47 students. This study showed that PRS worked effectively as an assessment tool during the semester to provide feedback for the students and lecturers. Moreover, the study indicates an improvement in student learning

based on the improvement in their exam grades. However, this study was limited by the small number of participants and the fact that they were solely from the female department.

In another study at King Abdul Aziz University, the Smartphone was used as a voting system to choose answers (Awedh *et al.*, 2015). Here, PRS was used to promote collaborative learning at a community college in Jeddah, Saudi Arabia. The sample population comprised 38 students attending a computer architecture course and the results of the study reveal that collaborative learning and student engagement in the class improved learning performance. This is an indication of the possibility of the successful implementation of constructionist learning in Saudi Arabia using PRS. However, this study was also limited in terms of the sample size and the time allowed for collecting the data (only a month).

13. Overview of the reviewed literature, leading to the formulation of research questions

In this chapter, many educational research studies have been reviewed on the use of PRS in Higher Education for teaching and learning. Various studies have informed this research by exploring the effectiveness of PRS in different contexts for teaching and learning in Higher Education in different countries. The effectiveness of using PRS has been applied to a number of factors in education, including increased interaction, participation, attention, attendance, learning performance and understanding. Although there is clear evidence in the reviewed studies about using this technology in education, there were not clear indications of the effectiveness of its use in Saudi Higher Education. Additionally, the reviewed studies have provided support for AT to be applied as a theoretical framework for future work, including the present research. The gap in knowledge

evident from the literature review helped to formulate the research questions specifically for using PRS in Higher Education in Saudi Arabia. The current study is distinct from previous studies because it is situated in Saudi Arabia, which is a different context from the previous studies and furthermore, the sample includes both students and lecturers. Additionally, this study will apply systemic approaches (Grounded Theory and Activity Theory) for the collection of data and subsequent analysis of the use of PRS. The study will focus on the process of learning using PRS and possible changes to the experiences of both students and lecturers. Additionally, it will examine the implications of using this technology in Higher Education in Saudi Arabia. Based on these considerations, the research questions were formulated as follows:

1) How does PRS influence relationships in the context of education?

2) How does PRS influence students' experience in the educational environment?

3) What are the implications of using PRS?

The next chapter will clarify the framework for this study, which is Activity Theory (AT) for analysing the use of PRS. Additionally, the justification for using AT to analyse the use of technology in Higher Education.

Chapter 3: Theoretical Framework

1. Introduction

In this chapter, Activity Theory (AT), the theoretical framework for this study, will be discussed. This chapter will focus on the history and background of AT, three generations of Activity Theory and define the various activity levels.

Although PRS has been widely used elsewhere in education, it has only recently been introduced into Higher Education in Saudi Arabia. Generally, the lectures in Higher Education in Saudi rely on traditional education. The introduction of PRS as a technology for teaching and learning has changed the educational environment. There are many changes related to student and teacher attitudes towards their roles in class. Moreover, the relationship between students and teachers has been affected by this new technology. Additionally, it is expected that the learning process, especially learning activities aimed at achieving objectives, will change as result of the introduction of this technology.

Fundamentally, learning is a social activity occurring through interaction and communication on a social basis with other individuals (Vygotsky, 1978b). However, this interaction or the relationships between the components in the learning activity can be a source of contradictions. Taking these aspects into account, this research needs to apply a concrete framework to illustrate the benefits and constraints of this technology. Therefore, AT will provide a vital framework to support the exploration of the complex nature of the relationships between the many components of a PRS activity. Moreover, it will aid in understanding the interactions between individuals and their learning processes. According to Kuutti (1996) "*Activity Theory and the concept of activity seem to be particularly suitable and rich to be used as the starting point in studying contextually*

embedded interactions" (p.37). Therefore, Activity Theory is a suitable approach to understanding complex relationships and the activity as a whole.

2. Activity Theory overview

Practicing in any human activity normally involves working towards goals within the context of a community. An activity has been defined in the literature as engaging the subject (teacher or student) with a goal or chain of goals (Ryder, 2007). The function of AT is to illustrate the actions in an activity and the process for these actions constituted by a community that engage in processing this activity to reach the objectives (Waite, 2005). Therefore, AT was defined as a philosophical and cross-disciplinary framework to understand human activity and the process of development for these activities (Kuutti, 1996). Jonassen and Rohrer-Murphy (1999) state that AT is not a methodology, but is considered a framework to analyse and understand human activities for individuals or a community while considering the context in which the activities are carried out. In the literature, AT is used to understand the use of technology in education and shape better practice for technology use (Scanlon & Issroff, 2005). This function of AT is consistent with the aim of the present study and aligns with the constructionist paradigm (Jonassen & Rohrer-Murphy, 1999). For instance, the third generation of AT relies on multiple voices and this is the philosophy for the current study, which will take into account the different perspectives of the different participants and will thereby build an understanding of PRS and its efficacy based on their perspectives.

3. Background and generation of Activity Theory (AT)

The main purpose of using a cultural historical framework is to study human activities. In this study it is used to analyse the learning activities within PRS.

Vygotsky introduced socio-cultural theory a few years after the Russian revolution (Kao, 2010a). The concept of AT is based on the idea of meditated action (Vygotsky, 1978b), where an action is used as a unit for analysis. AT provides a holistic approach to analyse learning and also the context of that learning. Activity Theory (AT) is thus based on the work of Vygotsky (1920, cited in Chaiklin, Hedegaard and Jens, (1999). Vygotsky's concept is that every human activity has mediating means (machines, writing, speaking, gesture, architecture, music, etc.) to achieve its objectives, transforming it into an outcome (Engeström, Miettinen & Punamäki, 1999). Vygotsky represented his concept in a triangle (figure 4), which became the first generation of AT. The model contains subject, tools and objective. These nodes are now known as subject, object and mediating tool (Engeström, 2001). The mediating artefacts which influence an individual to act as a reaction to the learning process can be social artefacts. Leont'ev (1978) argues that the subject's object-directed actions and the operations for these actions are part of a wider collective activity system. Based on Leont'ev's opinion the activity system is the unit for analysis.

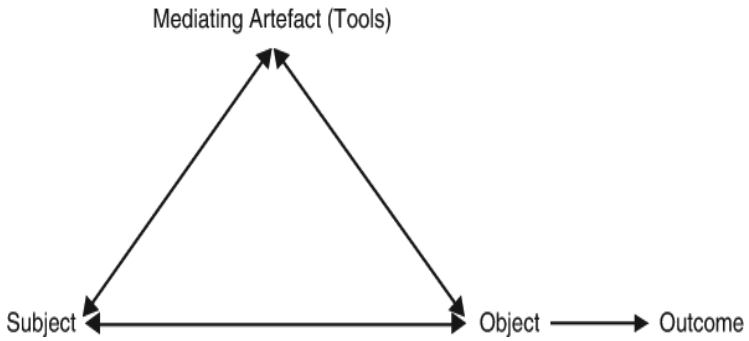

Figure 4 First Generation of Activity Theory

In this generation of AT, the person (subject) who is processing the activity applies their experience, history and needs to the activity. For instance, subjects use experience and history to process teaching activity with the best tools from

their experience (moral teaching or using technology). Moreover, the experience here will influence the best way of processing the activity. For example, the experience of a good teacher with a tool will be used within the teaching.

The tool is used here to transform the objective to an outcome, regardless of the type of the tool. The tool can be psychological or material (Kozulin, 2001). Nevertheless, psychological tools can be internally directed, transforming the inner, natural psychological processes into higher mental functions, therefore controlling the behaviour and cognitive process of individual. On the other hand, material tools are aimed at controlling the processes in nature, which are externally oriented. Therefore, in order to understand learning activities with PRS we need to understand the external and internal activities that may be affected or changed through the use of PRS. Furthermore, researchers should note a difference between objective and objectivity (Bedny & Harris, 2005). The objective refers to the needs and desires which are modified and explored by the subject of the activity, whereas objectivity is related to the goal of an activity. In this view the subjects may have different needs, objectives or motives, but they might work toward the same objectivity.

The work of Vygotsky was the foundation for AT and subsequently was developed by Leontiev (Issroff & Scanlon, 2002). However, the first generation of AT was treated with criticism (Issroff & Scanlon, 2002; Kuutti, 1996). For example, Issroff and Scanlon (2002) reported that the first generation focused on the concept of mediation without considering the relationship between the subject, the community and the environment.

The objectives of the activity system indicates the needs of or problems for the subjects which the activity is directed at and these objectives can be transformed

to a successful outcome using psychological or material mediating tools, whether external or internal (Roth & Lee, 2007). The objective is identified by the subject and can be tangible or intangible. There are needs or motives behind the objective which encourage the subject to process the activity (Rodriguez, 1998). Kuutti (1996) states that:

"*This structure is too simple to fulfil the needs of a consideration of the systemic relations between an individual and his or her environment in an activity, however, and thus a third main component, community has to be added*" (p.321).

From this criticism we can see the first generation of Activity Theory is limited in terms of its power to analyse the community and the social relationships between individuals.

The second generation of AT was developed by Engeström, who argued that artefacts are an integral and inseparable component of human activity. Nevertheless, the emphasis should not be focused on the artefacts only, for example in the classroom, nor only on the content or technology; the other components must be considered. Essentially, the mediation of the activity should consider the relationships between the other factors of the activity system (Engeström, Miettinen & Punamäki, 1999). As a result, Engeström expanded Vygotsky's triangle. This expansion of the original Vygotskian triangle aims to clarify the social/collective elements in an activity system, through the addition of the elements of community, rules and the division of labour, which were not considered in the first generation, while emphasising the importance of analysing these components' interactions with each other. The transformation of the objective to a successful outcome will occur through interaction between the components of the activity (Engeström, 2001). This expansion will allow

researchers to examine a human activity within its complex environment. When the social elements are determined and demonstrated it will help the researcher to provide a strong interpretation for the activity, thus bridging the gap between the individual subject and the societal structure. It can be exploratory in approach for the social activities.

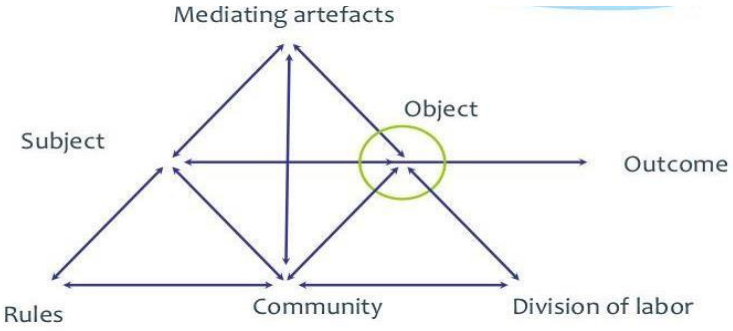

Figure 5 The Second Generation of Activity Theory (Engeström, 2001)

The integrated components of the second generation (rules, community and division of labour) were defined by Yamagata-Lynch and Haudenschild (2006). The rules were defined as factors that control the involvement of the subject in the activity. The group of individuals or institution of which the subjects are a part, is labelled as community. The third component is the division of labour, which refers to roles or responsibilities in the activity assigned by the community. These components and the previous components are interrelated with each other. Therefore, these components work to gather to transform the objective to an outcome. Barab et al. (2002) has illustrated that:

> *"The components of activity systems are not static components existing in isolation from each other but are dynamic and continuously interact with the other components through which they define the activity system as a whole. From an activity theory perspective, an examination of any phenomenon (e.g.,*

learning in the classroom) must consider the dynamics among all these components" (p.79).

Scholars have seen the second generation of AT as revolutionary, going beyond learning theories (behaviourism and cognitivism) which look at the individual learner in isolation from the environment where the learning takes place (Young, 2001). Although the second generation of AT has covered social contexts by adding important components, it nevertheless faced some challenges in dealing with different activity systems with shared objects. This was confirmed by Engeström (2001):

> "*When activity theory went international, questions of diversity and dialogue between different traditions or perspectives became increasingly serious challenges. It is these challenges that the third generation of activity theory must deal with*" (p.135).

Therefore, there is a need to examine this issue further to allow for interaction between different activities systems with a common objective. Moreover, allowing different perspectives from activity systems would facilitate understanding for the activity and the process of the transformation.

The third generation of AT was therefore developed by Engeström (1999), who believed that the individual activity was not the only unit of analysis for AT, but other aspects such as joint activities or practices should be incorporated. The third generation of AT deals minimally with two interacting activity systems, for example, teaching activity and learning activity. Therefore, the activity systems include different activities, but lead to a shared objectives.

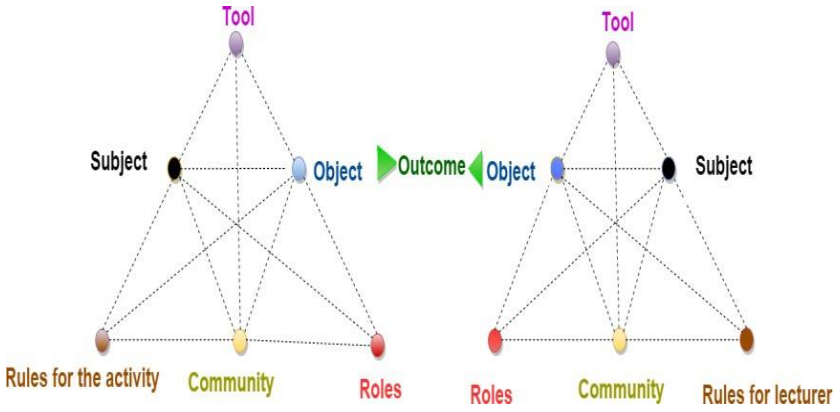

Figure 6 The Third generation of Activity Theory

The objectives of each activity are not minimized, but moved to short-term objectives. The initial objective has been moved to a more common and collective objective between the activity systems. For example, in this study the students want to learn and understand the content as the objective of their activity – objective 1. The second objective (2) for lecturers may be helping students to learn and understand and improve their methods of teaching with technology. The shared objective here is improving learning. Through these activity systems there are possibilities for contradictions from both systems through the interaction between them, which can be resolved to improve the system as a whole.

The internal tensions and contradictions between these systems are seen as vital factors to develop this structure of systems. Moreover, by organising these activities, the smooth transition between them will help to transform the objective to an outcome. The third generation of AT was founded to develop the conceptual tools to understand dialogues, multiple perspectives and a network of interacting activity systems.

4. The principles of Activity Theory

AT was built on a set of principles to generate a systemic framework, rather than a highly predictive theory (Kaptelinin & Nardi, 1997). Engeström (1999)

summarises the third generation in five principles which overlap and are not isolated from each other. The first principle is that the main unit of analysis in AT is the activity system and the actions and operations are independent, but subordinate to units of analysis. Activity systems can be determined by generating actions and operations. Therefore, it is important to analyse activity systems to understand them and possible ways to develop them.

Secondly, multi-voice implies different perspectives, interests and traditions that can be a source for development and changes. The community involved in the activity has more than one individual, so every individual has different experience and history. This background will influence an individual's role in the activity. Moreover, this background will affect the way each person uses or sees the tool. That will provide different perspectives in different networks of activity systems. This will be a source for contradiction and improvement for the transformation.

The third principle is the history of the activity systems. An activity system is built over time. Essentially its developmental history plays an important role, whereby any difficulty faced in improvement can be understood through an examination of that history. History itself needs to be understood both on a local level (the history of the activity and its objectives), and more generally (as a history of the theoretical ideas and artefacts that have constructed the activity).

The fourth principle is that contradiction can occur through the tension between activity systems and transformations. According to Engeström (2001):

> "*Contradictions are not the same as problems or conflicts. Contradictions are historically accumulating structural tensions within and between activity systems. The primary contradiction pervades all elements of our activity systems*". (P. 137)

The openness of the activity system, when introducing a new component from outside (new technology or new martials), normally causes a secondary contradiction. This contradiction might result from the interaction between the new component and the old components (rules, or division of labour). Such contradictions generate distraction and clashes, but also opportunities for creative attempts to change the activity.

The final principle of expansive learning is expansive transformation in activity systems through the reconceptualization of the objective and the motive of the activity (Engeström, 2001). The activity system constantly progresses through long cycles of qualitative transformation. The rise of contradictions encourages the individuals who participate in the activity to ask about these contradictions and change the norms to improve the activity. The effort to change the norms increases with collaborative insight.

5. Levels of activity

The mechanism of the activity is to be performed by subjects toward achieving an oriented objective in order to transform it into a successful outcome. This process of transformation normally does not occur in isolation, rather it is a long, cyclic process. The PRS activity includes many actions (asking questions) and the processes for these actions are called operations. The basic levels of activity are activity, action, and operation. Wilson (2006) represented how the activity is processed through the three levels, thus (Figure 7):

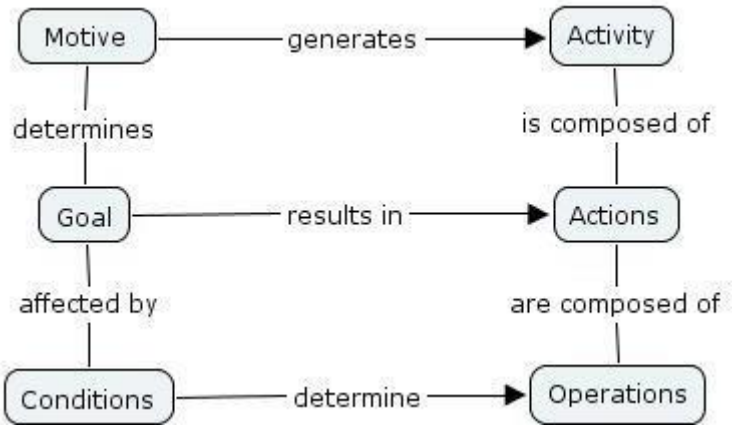

Figure 7 Activity levels (Wilson, 2006)

The actions are associated with objectives or goals, each action is performed towards the completion of a short-term goal. Operations are processed towards achieving a long-term objective. For example, a person who is hungry will undertake a lot of actions to get rid of hunger during the operation (preparing food, eating and other actions). The activity is associated with motive, while action is associated with a goal and operation is associated with conditions. The goals and motive will generate the activity, which will be identified before being applied in reality. Moreover, the motive will determine the goal, which will result in the action or chain of actions. Each activity consists of an action or chain of actions in order to achieve the main objective of the activity, which is shared by all participants. An activity can be performed by completing a number of actions to achieve partial goals towards achieving the main objective of the activity (Leontiev, 1979). In some conditions, actions will be transferred to operations. As Kuutti (1996) explains:

> "*Before action is performed in the real world, it is typically planned in the consciousness using a model. The better the model the more successful the action,... when the corresponding model is good enough and the action has*

been practiced long enough…the action will be collapsed into an operation, which is much more fluent" (p.31).

For example, a teacher has a model in her/his consciousness for posing a question to students every lecture, including how to write the question, allowing time for asking the question and how to ask it. Therefore, the lecturers and students plan their actions to achieve their short-term goals and have a model in their consciousness to process these actions. All or some these goals can be related to the same actions (for example asking or answering questions), but at different times and in different formulations (individually or collectively).

The operation level is applied to understand the conditions of the actions and how the actions work in these conditions. Moreover, at the operation level we can take into account the affordance and constraints of PRS technology. For example, the way to use PRS and the purpose of using it can differ at different points during the lecture, at the beginning of the lecture or at the end. Each question has particular conditions and these conditions effect the operation for that question. Some questions can be asked at the wrong time and these questions may not achieve their goals because the timing of the questions was unsuitable.

From the levels of activity we can understand that activity levels are not fixed but dynamic, and interact with each other. Therefore, human activities are constantly changing and developing, including the actions and operations associated with them, which are an inseparable part of the activity. In this way the PRS activity will be explored based on the objectives and motives for the activity. During the PRS activity both lecturers and students are processing different actions towards achieving the short-terms goals (to answer questions) to achieve the objective (understand the content) of better learning and teaching.

6. Activity Theory for using technology in Higher Education

Currently, many believe that the use of technology is important in supporting learning in Higher Education (Rienties, Brouwer & Lygo-Baker, 2013). Many of these technologies have not yet been effectively evaluated to determine whether they meet the anticipated objectives. Evaluators need to provide a list of the changes to a Higher Education environment and a list of recommendations for the future the introduction of such technology entails. Such evaluation requires the involvement of all individuals in the learning environment, because technology and other social and cultural components may effect the use of the technology. This evaluation required me to make decisions about the influence of technology on student learning. Evaluating the use of technology by analysing the outcome or trying to maximise outcomes is a limited approach. The evaluation should consider the entire learning context, which includes students, teachers, materials, technology and the interaction between all of these components (Scanlon & Issroff, 2005). However, evaluating the learning process for students using technology in Higher Education is a complex process (Oliver & Harvey, 2002). The complexities arise in terms of identifying external and internal changes (for example understanding, solving problems, ability to think critically, and so on) in both learning and academic practice. In other words, the mechanism of the learning, whether students are expected to construct their understanding or show their understanding might be difficult to fully explain using other frameworks. Generally, the two problems which have been identified for using simple evaluation models concern the limitations of these models and the complexity of learning settings (Scanlon & Issroff, 2005). Therefore, it is clear from the literature that evaluators need a richer conceptual framework to look at the use of technology in Higher Education instead of using the available approaches. What

is required is a conceptual framework that considers all the factors and a flexible theoretical framework that can be expanded to include the relationships between these factors.

AT has been used in different ways to evaluate the use of technology to promote learning in Higher Education (Scanlon & Issroff, 2005). The framework was used as an approach to analyse data and to understand the use of PRS as a method for collective learning (Issroff & Scanlon, 2001). Additionally, AT was used as framework to understand the students' and lecturers' use of technology in a learning setting (Issroff & Scanlon, 2002). In another study conducted by Hague and Dolonen (2012), AT was used to design and evaluate a framework for online learning resources. They reported AT is an effective approach for evaluating and designing online resources, overcoming design problems and providing pedagogical ideas (Hauge & Dolonen, 2012). Price, De Leone, and Lasry (2012) used AT to compare PRS and flashcards to find a role for the tool, and using collective learning approach for both tools. They found AT useful to assess the influence of both methods on students' learning (Price, De Leone & Lasry, 2012). In Brazil, AT was used as a new model to test methods of teaching mathematics to freshman at the University of Minas Gerais (Campos & Pinto, 2016). AT was a vital framework to analyse the activity and the see the changes and constraints of the new technology on the learning process in this case. The previous studies show the effectiveness of AT in their investigations.

Fundamentally, applying AT in the evaluation of education technology in Higher Education implies that these technologies are a tool for the community. Moreover, the subject of the activity can be the student, or lecturer, or both, while the shared

objective of the activity is always learning. The community for the activity is the classroom, which includes students, lecturers and individuals associated with using technology. AT is flexible enough to include many components of the activity and aspects, especially in its third-generation iteration. More importantly, the flexibility of AT offers a framework and language to describe the development in learning settings. Scanlon and Issroff (2005) reported:

> "*...the language of Activity Theory was useful to express key features of the learning experience, and to consider ways in which practice in subject areas was changing and was reflected in teaching approaches. These experiences encouraged us to consider how Activity Theory might be useful in enriching our view of the activity of evaluation*" (p.432).

Evaluating the effectiveness of technology (PRS specifically) in Higher Education as an activity needs judgement about its value. AT has proved to be an effective approach to discover the value of using technology in Higher Education comparing with other available approaches. Therefore, AT is a vital approach to understanding learning with technology in Higher Education.

7. Using Activity Theory in the current study

In recent years, there has been a great deal of global interest to use AT as a theoretical framework to study and understand human activities in different research fields. AT was used, for example, to identify contradictions and tensions that shape developments in educational settings (Yamagata-Lynch & Haudenschild, 2006; Yamagata-Lynch & Smaldino, 2007); information systems (Crawford & Hasan, 2006); human-computer interaction research (Bødker, 1996; Kuutti, 1996; Nardi, 1996); cognition and communication at work (Engeström & Middleton, 1998); and education (Engeström, 2001), in Higher Education (Scanlon & Issroff, 2005).

The purpose of this study is to analyse and understand the use of PRS in Higher Education, using AT to provide a framework, as discussed above. AT helps to analyse more than one activity system with shared objectives to improve learning and teaching. This study aims to conduct a qualitative investigation to analyse the use of PRS for teaching and learning in Higher Education in Saudi Arabia. The investigation in this study will consider varying perspectives from both students and teachers. It will focus on using PRS in Higher Education to improve learning and to understand the learning process with consideration of interactions between students and teachers. To fully understand how the interaction between activity systems and elements that may influence the activity, it must be analysed in the context of KSA. The learning process cannot be fully understood without understanding the social or institutional context for the learning process (Liu, 2004).

Therefore, the reason for choosing AT as an investigative framework is the unsystematic use of technology as a tool for learning, and other resources, and the weak concept of learning as joint activity (Engeström, 1993). Therefore, the evaluation of technology is not normally carried out in a rigorous manner underpinned by theory; and in such evaluations, the concept of joint activity is not normally considered. The previous studies have not been carried out in a rigorous manner to support the educational theories used. These studies have not considered learning as a joint activity.

Moreover, studies undertaken on PRS technology mostly concentrate on students or on the lecturer only, or on specific aspects of learning in isolation. AT will give a clear, more holistic view of the learning process, considering all the other components in concert. However, the relationships between these aspects

were not studied or understood in order to conceptualise the proper use of PRS, as discussed in the literature review. AT will be used as a theoretical framework to understand these relationships and how important they are to achieve the goal of the activity.

Through the relationships between the components of PRS activity, the whole educational environment can be understood as a joint activity. Constraints in the activity can be clearly discovered, along with the reasons behind them. In addition, this approach may offer suggestions for further development of the activity itself. Furthermore, understanding the relationships between the activity factors will offer a clearer view of the PRS users' (lecturers and students) experiences. In other words, what are the relationships between a teacher and student, and between students and other students, and how have they changed after using this technology? How has the experience of learning and lecturing been changed by PRS? The relational approach suggests that technology or other factors of activities (students or teachers) cannot work in isolation without having affordable relationships with each other (Jones, Dirckinck-Holmfeld & Lindström, 2006). In addition, the relational approach is an effective approach to assess the nodes and how they work with each other instead of studying the nodes in isolation. Therefore, studying the combination between the components in the learning activity is important to show the mechanisms of learning.

Therefore, using AT as a framework to analyse the relationships between the factors of the activity and the dynamic of AT is an effective way to understand these relationships. In addition, from an Activity Theory perspective, the activity is the interaction between the subject, object, motivation, action, goals, tools and socio-historical context. Transforming the objective to an outcome does not rely

on the factors of the activity only, but on the specific features of the internal structure of human activity itself and the relationships between these factors (Leont'ev, 1977).

8. The proposed PRS activity

The proposed structure for the PRS activity uses the third generation of AT to represent two activities. The rationale for choosing the third generation of AT is that it allows the investigation of PRS use in two activity systems and from different perspectives. Figure 8 gives an example from an AT perspective of how each one of those activity systems can be analysed and classified in the following way:

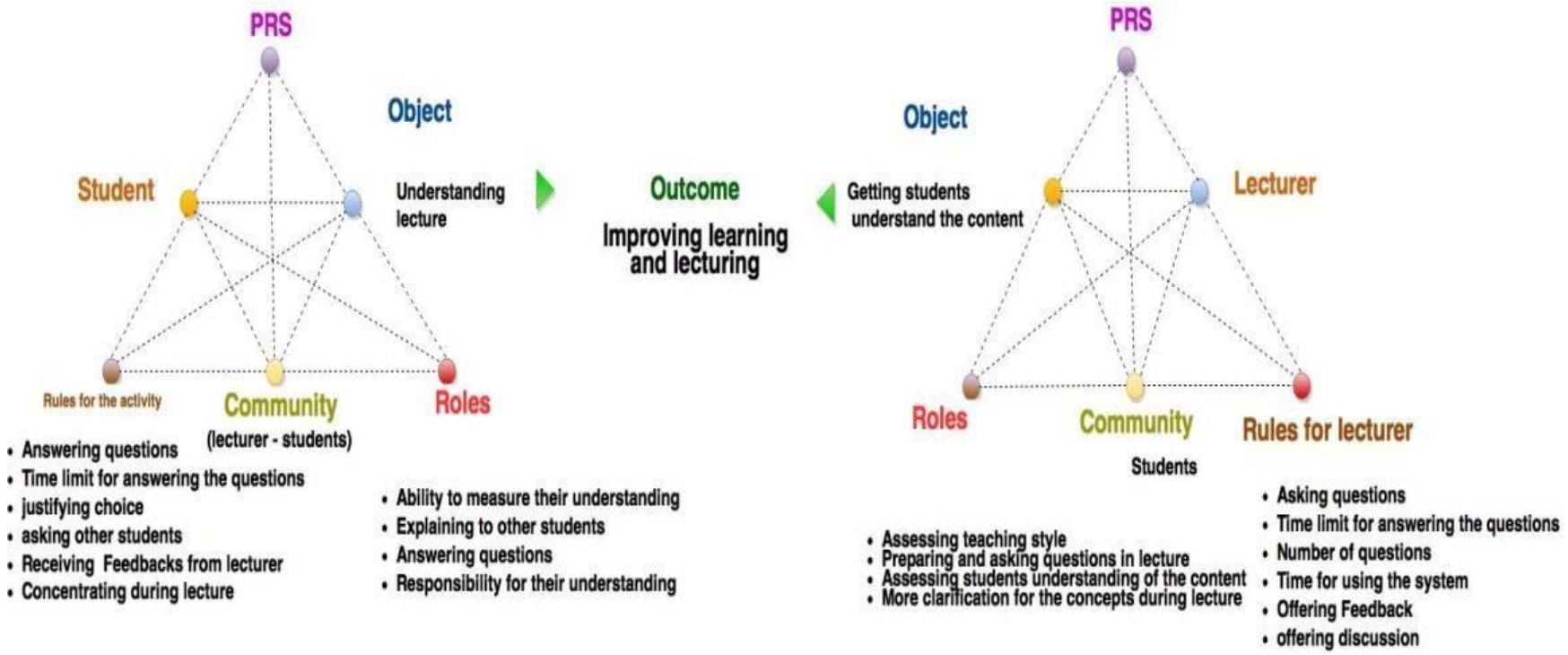

Figure 8 The proposed PRS activity

The first activity system is for students and the second is for lecturers. It was proposed that both subjects (students and lecturers) have different objectives, rules and roles. However, they are all using PRS as tool to reach their objectives. The main components of the structure are subject (lecturer, student), community (for example, the classroom), and objective (understanding the content of lecture for the student and helping student to understand for the lecturer). The other component are mediation factors between the subject and their objectives. The tool in this structure is mainly PRS, but includes other types of tools (for example, learning materials and signs). However, this study focuses on PRS as a mediating tool while considering other components. In order to process the activity, the subject (lecturer or student) needs to interact with the community (other individuals) in their environment by using the mediating tool, applying the rules for the activity and playing the expected role of a user. As Engeström (1993) stated, "*learning is a joint activity*".

The relationship between subject (lecturer, student) and community (other students) is mediated by the rules. The rules are explicit and implicit norms, conventions, and social relationships within a community. The rules in the activity system will be different, as the rules for the students are different from the rules for lecturers. This relationship is influenced by the tool itself and what is being offered by PRS through the technology's impact on the rules. The PRS system allows the lecturer to pose questions to the students, who answer the questions using their devices. This demonstrates the communication between the students and the teacher and the different rules for each participant. This relationship is controlled by the rules of the activity. The pattern of asking questions and the time allotted for asking these questions are examples of the rules for the activity. This refers back to affordance theory, whereby PRS offers affordance to ask and

answer questions (Gibson, 1977). Using PRS may elicit physical and psychological changes to the way students act in the classroom.

Moreover, displaying the percentage of wrong and right answers for the students is one of the rules of the PRS activity. This may help lecturers to measure students' understanding and give feedback during a lecture. Presenting the students' answers may change lecturer behaviour during the lecture. The lecturer can give further explanation if many students chose the wrong answer or move to a new point if they all chose the correct one. Nevertheless, the rules of the activity may negatively affect the relationship between the lecturer and the students. This may not help if the lecturer does not apply the rules of the activity. Therefore, answering the PRS question is not enough to improve learning without altering the relationship between students and between the students and their lecturer. In other words, giving feedback is an essential rule for the activity. Offering the questions without a plan to use PRS and allowing time for discussion and offering feedback might not be helpful as the students may not have the confidence to participate in the activity. The duration of the lecture and the number of questions asked during the lecture can influence these relationships. The amount of information in a lecture and its duration may not hinder frequent use of the PRS. Students may have less interaction with the lecture, so that weak rules may affect the relationships.

Furthermore, the relationship between the students themselves is mediated by the rules of the activity. The student is considered to be the subject of the student activity, because s/he is using the PRS and answering the questions. Through asking questions of other students before answering and having discussions after each question with their classmates, they start to interact with each other by

asking questions, justifying their answers, learning new English terms and explaining their answers.

Asking questions during the lecture will help students to communicate more effectively than in the traditional lecture. Before answering the questions they can ask each other about a new term or for clarification if the question is unclear. After each question, they will ask each other for justification or more clarification. During this process there is a greater possibility for the students to achieve their objectives. The rules of using PRS individually, answering or asking questions and having discussions after each question may encourage this relationship. Such features were previously unavailable in the traditional lecture. Nevertheless, throughout the framework of this study any contradictions in PRS activity on the relationship between students will be explored.

In the traditional lecture, the teacher's role is to deliver the lecture through the presentation of information through speech, with minimal involvement or participation from the students. The student role is receiving or listening to the information provided by the teacher. This occurs when the student is positively influenced by the rules of the activity, which will positively change his/her role in the lecture.

The framework may work effectively if students' attitude towards the traditional lecture changes after using PRS, for example, participation, understanding, attention and their ability to engage in the learning of the English language. However, the lecturer or students may not play their roles effectively to support the construction of understanding. For example, failing to provide feedback to students will not help those who are in difficulty, creating a gap in their knowledge

and prompting them to fail to reach their objectives, as they might not understand the content or misunderstand concepts.

Essentially, the relationship between the PRS and the objectives is vital. PRS must be useable and suitable for the objectives to be achieved. Many types of PRS technology are not inappropriate for use in the classroom and difficult to install. Technical problems may prevent both students and lecturers from achieving their objects. For example, losing connection between the devices and the receiver, and other problems may occur during the lecture, leading to distraction and frustration among the community. Therefore, achieving the objective cannot happen where there is a weak relationship between the PRS and the objective. Thus it can be seen that there is a solid relationship between the components of the activity.

Any constraints between any elements of the activity will affect other relationships and the entire activity in general. A dynamic activity will lead to achieving the objectives of that activity and thereafter, transform the objective into an outcome. The anticipated outcome for this activity is improving learning and lecturing. The activity cannot work without an effective connection with every component.

Contradictions are essential components of AT. In any activity system, one or more contradictions may have an influence on the activity. Contradictions may occur at any time and between any of the components. These contradictions need to be analysed and their cause established. Examples of these contradictions are the way the lecturer uses the PRS, students' desire to use the system, appropriate application of the rules of the activity, and technical problems. Finding solutions for these contradictions will lead to a smooth attainment of the objective.

Contradictions may occur between the components at any time during the activity. These contradictions occur as result of various conditions, for example failing to apply the rules or fulfiling the essential roles during the activity. The contradiction might stem from the system itself as it can sometimes be difficult to use, limited in terms of asking some types of questions or due to technical problems. Therefore, an analytical framework that enables the analysis of the most important aspects, considering the following must be sought: firstly, the relationships between the components and the complexity of the interaction between them. Secondly, analysis of the contradictions in the relationships between these components in PRS activities. Thirdly, the analytical framework needs to be consistent with the philosophical assumptions of the methodology for the study. Roth and Tobin (2009) asserted that: "*Activity theory has been used successfully to analyse successes, failures, and contradictions in complex situations without reductionist simplifications*". Therefore, this study will use AT as a theoretical framework to evaluate and understand the use of PRS for learning and teaching, and to understand the relationships and interaction between the components in the PRS activity, along with any contradictions within the PRS activity.

9. Summary

This chapter has described the theoretical framework for the study. It began with a history and background for Activity Theory. The three generations of AT and the development from first generation to third generation were explained. The principles of AT were illustrated in this chapter, along with the levels of AT, which include activity, actions and operations; these principles and levels were explained in detail. The justifications for the use of AT in this investigation was presented with consideration of the concept of AT and the nature of the study and

applied specifically to the use of PRS for learning and teaching at undergraduate level in the context of Saudi Arabia.

Although AT is a descriptive framework, it helps to illustrate complex relationships and contradictions among them, and consequently the development of the activity. The main focus of this study is to understand the learning process in order to help develop or improve it in future. The next chapter will focus on the research design and illustrate the methodology used in the present research: case study methodology. I will also discuss various methods of data collection and analysis used in this investigation to obtain comprehensive responses and to address the research questions.

Chapter 4: Methodology

1. Introduction

The main purpose of this chapter is to outline and provide a rationale for the philosophical and methodological framework used in the current study, conducted at King Khalid University (KKU) in Saudi Arabia, to examine PRS activity and to evaluate how the factors involved in this activity are related to each other. Therefore, this chapter will specifically outline and discuss the methods used to address the research aims and objectives of this study and also to describe the research approaches; provide a rationale for the choice of research methods; explain the data collection instruments and procedures; describe the recruitment of participants as well as discuss ethical considerations, which form an integral part of the present study.

In order to gain an empirical insight into the complexity of PRS activity in Higher Education in a Saudi context, the current study will rely on a qualitative approach, and therefore a case study. As part of the case study approach, semi-structured interviews, group interviews and an open questionnaire will be used to collect data from the participants. In this chapter, when referring to the ontological and epistemological stance I take in this research I use the term constructionism (Burr, 1995; Crotty, 2003). This differs from social constructivist learning theories, and I use the term social constructivism when referring to learning theories.

2. Research paradigm

There are several research paradigms which combine ontological, epistemological and possibly other theoretical positions, such as positivism, constructionism and critical realism. These paradigms are used by researchers as guide for them to conduct research. There are differences between them in terms of their reality, methods and methodology. The positivism paradigm is

defined as a scientific methodology aimed at using quantitative methods (experiment or survey) to both present and find the truth (Henning, Van Rensburg & Smit, 2004). This paradigm is used in some social science studies; however there is some criticism exists against its use as it does not suit qualitative research because it is objectivist (Gill & Johnson, 2010; Johnson & Duberley, 2000; Smith, 1998). The social world is complex and interconnected, and positivist approaches, which tend to be reductionist and rely on quantification, are insufficiently sophisticated to allow for an understanding of the complexity of sociocultural activity (Burr, 1995).

In the development of social science, the most common research paradigms are social constructionism and critical realism (Fleetwood, 2005; Losch, 2009). However, there are differences between both paradigms in some aspects. In the critical realism paradigm, researchers believe that some of the structures leading to observable events are hidden, but have an objective existence independent of the workings of human meaning (whereas most constructionist believe that such structures, which can still be relatively stable and socially shared, are constituted within human activity). In this sense, the social world or social reality can be understood only if people understand the social structures that generate such unobservable events. The term ‘unobservable’ refers to the concept of critical ontology, whereby the reality is out of the human mind. Therefore, critical realism differentiates the appearance of the reality from its essence (Losch, 2009). In critical realism structuring people’s behaviour is external and not observable, whereas for constructionists, the factors which structure peoples’ behaviours lie within and not outside of people. I will be looking at activity systems within people and not those independent from people, because people are an integral part of the social activity.

To distinguish between both approaches it is essential to understand the ontological and epistemological assumptions of each. The ontology refers to the social reality and how the paradigm describes that reality (Ramey & Grubb, 2009), and the epistemology is concerned with ways of creating and justifying knowledge (Cutcliffe & Harder, 2012). Those who consider the ontology fall into two opposing categories, relativists and realists, who have different viewpoints of the social reality (Burr, 2015). When the relativists start to investigate social constructivism, knowledge, truth and social structure, they encounter realists who disagree fundamentally with their ontological perceptions, and vice versa. Ontology within the critical realism paradigm states that "*the world consists of objects existing independently of human interpretation, knowledge, enactment, or discourse*" (Hedlund-de Witt, 2013, p.4). Therefore, critical realism not only deals with objects, but also with the relationship between objects. Moreover, the reality is not constructed by the individuals' sense of the critical realism paradigm, but exists externally to their mind; therefore the ontology is presupposing the epistemology (Scott, 2005). Thus, in critical realism the ontology (being, things, existence, reality, and the objects under investigation) are separated from the epistemology (knowledge, systems, thoughts, ideas, theories, and language). This perception creates the possibility for a fallible or flawed approach for describing the reality and the relationship between the components in the world, which cannot be justified in a logical sense (Scott, 2005).

For this reason, critical realism has received criticism from followers of the constructionist paradigm (Scott, 2005), as it is based on a constructed reality by interacting with individuals and making sense from different perspectives. Nevertheless, the critical realism paradigm allows constructionists to use constructionist epistemology as a means to discover knowledge (Maxwell, 2012;

Sayer, 1997). The constructionist paradigm has explanatory power through the relationship between the individual and society (Burr, 2015; Cruickshank, 2011), and the methodology in this paradigm relies on “interpretation, multiplicity, context, depth, and local knowledge” (Ramey & Grubb, 2009, p.80). Therefore, individuals’ views are seen as constructing the reality indirectly through language and interaction with other individuals (Raskin, 2008), meaning that this constructed reality does not reflect the ‘true’ reality, as in critical realism.

Moreover, social constructionism focuses on the relationships between individuals and the world to understand reality (Cruickshank, 2011), whereas critical realism focusses more on individuals and objective reality (Maxwell, 2012). In critical realism this concept may limit the observer’s ability to perceive the reality as they are an outsider and it is inaccessible. Critical realist epistemology is secondary to the ontology and is treated separately since knowledge of the phenomena or world relies on the nature of the phenomena or the world and needs to be discovered (Hedlund-de Witt, 2013; Scott, 2005). Based on the assumption that all knowledge or social theories focus on “*absolutely or relatively independent objects in the world*”, epistemologically, critical realism may use a constructionist approach for knowledge (Hedlund-de Witt, 2013). This indicates weakness in the relationship between ontology, epistemology and methods (Scott, 2005). This may raise constraints when choosing methods and analysing the data, such as the validity and reliability of the findings as a result of the philosophical considerations. This division between ontology and epistemology in

critical realism may lead to an inadequate relationship between reality and the means of determining and describing it.

Conversely, in the constructionist paradigm the ontology is conceptually different from critical realism, where the world is seen not as pre-existing, but created by interaction between the individuals under investigation (Houston, 2001). Constructionists do not separate ontology and epistemology, therefore the knowledge does not pre-exist or wait to be discovered, but is socially constructed through individuals' perspectives and interaction with the world (Gordon, 2009). This reduces the possibility of objectivity in research carried out within the constructionist paradigm, but shows that all knowledge is derived from social conditions, is value-laden and increases the validity and reliability of the findings (Gordon, 2009). Constructionists object to critical realism in terms of having fixed identities which produce fixed outcomes or a single truth, called "triangulation" (Scott, 2007). Whereas constructionists believe every individual may perceive the social world differently from other individuals, therefore many different perspectives may arise from different methods (Burr, 2015). Therefore, constructivists have generated the concept of "crystallisation" (Creswell, 2007), which offers a creative way of thinking and a valuable approach for producing knowledge (Charmaz, 2006). This approach is linked to Grounded Theory (GT) and other analytic systems (Ellingson, 2009); GT is informed the method in the present study. Ellingson (2009) defined crystallization as:

"*Thick descriptions and complex interpretations that at a minimum must include two or more genres that are interwoven, blended, and thickened to triangulate the data*" (p. 10).

Additionally, crystallization is divided into two categories: integrated and dendritic. Integrative crystallization means producing a written text consisting of multiple

genres. The dendritic approach involves conceptualizing qualitative research, which continually branches out into patterned, but unpredictable and unique epistemologies.

The narratives from individuals represent how they see society or the world. Moreover, the narrative should illustrate the meaning of the social context and the relationships between the components of society (Houston, 2001). Every individual has an individual perception of the world. In contrast, critical realism takes social objects for granted, rather than regarding them as formed either wholly or partly through social relationships. This often leads critical realist inquiries to focus on such objects in isolation rather than situating them in the web of relations which help form them (Cruickshank, 2011). Therefore, epistemology influences the choice of methods of analysing the data.

Bhaskar (1979, 1986, 1989) argues that social structures exist in the unperceivable transcendental realm of being, and thus claims that such structures form possible objects for empirical social scientific research. Nevertheless, Bhaskar's transformational model of social activity emphasizes that individuals build and formulate social structures through their actions and that normal effects of the structures are always mediated through individuals' intentional actions. For these reasons, Bhaskar avoids the integration of social structures into things that exist totally independently of individuals.

Bhaskar believes that assumptions regarding the existence of social structures and their normal powers can be illustrated by testing the terminologies used to describe individuals and their activities (Bhaskar 1989). In examples that highlight constraints in daily experience, he shows how intentional actions of individuals are subject to social structure. In classrooms, for example, the quality and nature

of spoken language both limits and enables agentic activity of both teachers and students, and the level of technological development shapes the range of teaching approaches and opportunities for their use available to educationalists.

Based on these views, Bhaskar assumes that approaches to research can demonstrate the existence of social structures set within webs of complex causality as they interact with agents such as teachers and students, enabling and constraining their activities (Bhaskar 1989).

The current study will be conducted in a Saudi context, therefore all social activity is culturally contingent and situated in KSA, i.e. it is based in cultural beliefs, attitudes, relationships and behaviour relating to the experience of teaching and learning in a Saudi education environment. The aim of the current study is to explore the use of PRS in Higher Education in Saudi Arabia, so to achieve this aim the research needs to obtain rich data from the participants in this social situation. The constructionist paradigm creates a very strong foundation for the use of qualitative research methods with the possibility of gathering richer data from participants (Ponterotto, 2005) including using interviews, as will be utilised in the present study (Aspers, 2004). Creswell (1998, p.51) explains that any study using the constructionist paradigm focuses on "*the meaning of the lived experiences for several individuals about a concept or the phenomenon*". Conversely, the critical realism paradigm offers less support for understanding how different methods of describing meaning acts within and between participants. For this reason, this study aims to explore and understand the lived

experience of using PRS for teaching and learning in Higher Education through qualitative methodology, putting this research within the constructionist paradigm.

Both paradigms (constructionism and critical realism) can utilise qualitative methods to conduct research, but quantitative methods may also be used (Mertens, 2014, p.9). However, the constructionist paradigm usually aims at making sense of a phenomenon instead of explaining it and making sense of the social world by constructing understanding from individuals' perceptions. The constructionist paradigm deals with qualitative inquiries using qualitative methods (interviews, group interviews, open ended questionnaire or observation). Therefore, the focus remains on subjective observation through direct experience from the inside rather than externally, allowing the researcher to make sense of participants' perceptions (Cohen, Manion & Morrison, 2013). Activity Theory (AT) is one approach that supports looking into the structure of activity from the inside rather than outside.

The current research will adopt AT, and it is important to determine whether it ought to be used within a critical realism paradigm or a constructionist paradigm. Socio-culturalist theories such as AT emphasize the relationships between individuals and objects in the social world to transform the objective to a successful outcome and suggest either that there is a meaningful objective reality which is inaccessible (critical realism), or that it is people who construct meaning (constructionism). However, the second position gives greater scope for understanding cultural differences in discovering meaning, and this is important for the present study, which uses Anglo-American literature and theorising to understand Saudi Higher Education practice and the relationship between objects in the PRS activity.

Critical realists adopt AT precisely as it was generated by Vygotsky, Leont'ev, Luria or Engeström because they believe both critical realism and AT (situated in the tradition philosophy which embraces Marxian themes of dialectically changing material and social reality) go beyond positivism and interpretivism. Allen et al. (2013) state that:

> *"Critical realism is, like activity theory, situated in a tradition which embraces Marxian themes regarding a dialectically changing material and social reality, themes that go beyond positivism and interpretivism."* (P9)

Thus, critical realist researchers tend to use the original AT as it was generated by Vygotsky, Leont'ev, Luria or Engeström to conceptualize the nature of reality and formulate deeper understanding about the activity and contradictions within that activity, as well as avoiding any dualism in social activity. According to critical realists, AT is rooted philosophically in critical realism, which offers a "directly applicable theoretical framework under realist social theory" (Kahn, Qualter & Young, 2012). Using the original AT will be adequate to explain the interplay between personal and socio-cultural factors in students' learning. Using other theories or frameworks may lead to dualism in the analysis, which might work against the ontological assumption for critical realism. Moreover, the use of the original form of AT with critical realism will solve the dualism of individual and collective thought in an activity (Stetsenko, 2005). Therefore, the use of the original form of AT with critical realism will allow the researcher to theorize the natural of reality, providing deeper understanding of contradictions and resolve various dualisms in social thought, along with enabling the realist to work within the implicit form of critical realism (Nunez, 2015). Indeed, it might be useful to use the original generations of AT with critical realism as it solves problems by using general cultural means (Wheelahan, 2007). As a holistic approach, AT considers

all the components that create the activity system and help to solve the contradictions in that system.

Additionally, in critical realism some studies use specific case studies to identify the structure and mechanisms of the social activity. On the other hand, some theories, such as AT, have a clear statement and structure, offering exploratory power. Therefore, critical realists prefer to use such theories as they are, without mixing them with other ideas, to constitute a clear image of the activity including the rules, roles for individuals participating in the activity and the interaction between them (Fleetwood, 2014).

On the other hand, Dewey claimed that the social environment is essential for mental growth and to improve experience, and therefore these tools are important for that growth and interaction with the environment (Postholm, 2008). In this sense, all the components in the environment are important and play an essential role in that growth, which increases the possibility of integrating and combining AT with other learning theories. Combining two theories in a constructionist paradigm will help determine the interaction between students and between students and their lecturer, and how these interactions support learning (Postholm, 2008). This will create a holistic approach to understanding human activity, with the social, cultural and historical aspects in focus.

2.1. Ontological assumption

The ontology was defined as the study of natural existence or reality and the structure of this reality as it is found (Crotty, 2003). Since the aim is to probe how PRS influences the students' experience in an educational environment, the current study will construct the reality by obtaining data from the perspectives of different participants (lecturers and students), therefore the ontology for the

present study is multi-realism. The perspectives of teachers in relation to the use of PRS in Higher Education are also considered in order to examine the different ways in which PRS could influence student-teacher relationships in an educational context. The reason for this is that participants' perspectives constitute the reality of how the PRS is being used for teaching and learning and how effective it is in improving the educational environment, along with any contradictions. Any reported contradictions in the views and experiences of the participants (students compared to lecturers) would help to meet another aim of this research, which is to identify any implications of using PRS. This approach is considered a social construction of the reality. These improvements and contradictions among different activity systems are socially constructed from multiple perspectives of all individuals involved in the study. As Pring (2000) reported:

> *"Rather is reality socially constructed and there are as many realities or 'multiple realities' as there are social constructions – which could be an enormous number. Research, therefore, is often focused upon people's 'perceptions of reality' where one lot of perceptions is as good as another" (p.60).*

The reality of the nature of using PRS for teaching and learning at KKU in Saudi Arabia exists, but externally to the researcher and therefore needs to be discovered and constructed through multiple perspectives from the participants. Therefore, since the current study is interested in understanding the influence of PRS on the learning process taking place in a Higher Education setting with due recognition to the fact that reality is socially constructed and can exist as multiple realities, the views of both the students and the teachers are considered in order

to develop an understanding of the use, effectiveness and implications of PRS in this Saudi University.

2.2. Epistemological assumptions

Epistemology is a philosophical term meaning “theory of knowledge” (Browaeys, 2004), or to study human knowledge. In the current study the epistemology is constructionism. In constructionism, Crotty (2003) claims that “meaning is not discovered but constructed. In this understanding of knowledge, it is clear that different people may construct meaning in different ways” (p.9). Moreover, Radnor (2001) asserts that: “*I believe that it is a multiple socially constructed reality; in other words, everyone has their own view on what they perceive reality to be*” (p.21). From that perspective, I believe that in this study they are going to construct understanding of the use of Personal Responses Systems (PRS) for teaching and learning at an undergraduate level in Saudi Arabia.

This construction is based on the reality of the participants’ perspectives, because there are many participants (teachers and students) with different insights about the effectiveness and contradictions of using this technology. This may effect their approach toward using this technology to achieve their objectives. In order to construct meaning from the participants’ perception of using this technology, the researcher aims to interact with participants to make their perceptions clearer and to elicit rich details about the situation. Crotty (2003) suggests, “*In this view of things, subject and object emerge as partners in the generation of meaning*” (p.9). Therefore, the research methods were chosen because they allowed interaction with participants (teachers and students) in order to collect rich data and interpret this data based on interaction and discussion.

3. Constructionist paradigm and Grounded Theory

Silverman (2005) explained that a social constructionist approach is mostly concerned with *what* people construct and *how* this process of social construction reveals itself. They further argued that the constructionist vocabularies give little attention to the *why* questions. On the other hand, GT addressed both the *why* questions as well as the *what* and *how* questions. Hence, it could be suggested that adoption of constructionism and GT could effectively help to develop a more in-depth understanding of social reality. Past research highlighted a possible inter-relationship existing between social constructionism and GT, with the former being a part of the latter (Charmaz, 2000). Nevertheless, it is important to note that how, when, and the extent to which grounded theorists rely on constructionist stances depends on the epistemological premises and research approach used in the study. Moreover, while research using GT has been preoccupied by the application of this method of inquiry, which ultimately leads to the emergence of superficial studies, the constructionist paradigm allows a much more innovative orientation whereby researchers are better able to grasp new understandings and engage in novel theoretical interpretations of social life (Charmaz, 2008) . Thus, in this research, GT is informed by a social constructionist paradigm that aims to capture the complexity of social interaction in relation to the use of PRS in the Saudi University.

Further support for the combination of GT and constructionism resides in the views of Andrew (2012), who stated that just as social constructionists place a lot of emphasis on the social practices that people are usually involved in as being the focus of enquiry, GT equally shares the same interest but perhaps with less attention attributed to the use of language as a tool to construct reality. Again, a

combination of both in this study provides the best opportunity to study reality as a multifaceted phenomenon that incorporates different elements characterising social interaction. As such, in line with constructionist approach, as well as the classical grounded theory, the nature of society is accepted as being both objective and subjective. In short, when constructionist paradigm merges its attention to context, action, and interpretation, together with GT analytic approaches, they are better able to benefit from in-depth analyses with explanatory power, while also being able to develop a conceptual understanding of the topic under study. At the same time, statistical evidence further reinforces the idea that incorporating the constructionist elements in GT creates a very robust research tool with multiple lenses to investigate how reality is constructed in society (Charmaz, 2008).

For the purposes of this research, there is an assumption that there is a relationship between the research philosophy and the research questions:

1) How does PRS influence relationships in the context of education?

2) How does PRS influence the students' experiences in the education environment?

3) What are the implications of using PRS on the educational environment?

Firstly, the idea of combining constructionism with the concept of grounded theory largely influenced the methodological stance of the current research, wherein the researcher aims to get as close as possible to the social reality of the participants using PRS in an educational setting, by considering all the elements characterising social interaction within a cultural setting. This idea clearly supports the nature of reality as being both objective and subjective, as discussed

above. Furthermore, with the aim of probing students' experience of PRS in an educational setting this research relies on an interpretivist approach in order to capture the meaning of the lived experience of the participants, while also being sensitive to the influence of culture on their learning process.

4. Research approach

The purpose of choosing a qualitative methodology is to capture the participants' experience. The reason for that is because the research aims to explore the subjective realties of the participants and it does not presuppose the reality of using the PRS in Higher Education. Basically, it was essential to allow participants (students and lecturers) to talk in order to construct a deeper understanding of their experience of learning with this technology. Using qualitative methods only may limit the responses to a small number of the students. Therefore it was vital to apply quantitative methods as well to have general view from the participants and support the findings from the qualitative methods.

GT informed the collection and analysis of rich data from the participants as it supports the qualitative approach. Using semi-structured interviews, group interviews and a semi-structured questionnaire will help to obtain detailed data about the participants' experience. The data and the themes that emerge from it, along with the relationships between these themes will be applied to AT. This process may help to elucidate an in-depth picture of using PRS at King Khalid University (KKU), where the data was collected. Later in this chapter, the literature of Grounded Theory will be examined, along with the use of theoretical frameworks to inform the building of theorisations from the data. Any critical points raised in this section will inform the structure of the

combination of Grounded Theory analysis with the use of AT and the data gathering preceding it.

4.1. Case study

The case study approach has been selected to holistically study the use of PRS at the university. Mainly, a case study approach is used to formulate a rich picture of individuals, institutions or a new tool (Hamilton, 2011). Furthermore, the case study approach can help researchers to understand a complex interrelationship, or series thereof (Hodkinson & Hodkinson, 2001). In addition to that, the use of case studies can help to develop a conceptual or theoretical framework (Hodkinson & Hodkinson, 2001). This approach can give the researcher a deeper insight into the individuals related to the case study, and their experience in a specific context. Moreover, the case study approach allows for different forms of data collection and provides different perspectives or viewpoints. The case study can be classified as high quality and valuable findings are based on using different perspectives and different kinds of data collection.

The case study approach can be used to analyse, observe, describe or explore, in order to capture the key components of the case. In this study, the case study approach is used to investigate the use of PRS at KKU. The case may be, for instance, an individual or a group of people, an institution or a specific authority. Essentially, this approach can cover a single case or multiple cases, depending on the purposes of the study. In the current study, this approach will include one institution and a single group of students and lecturers, therefore the single case study approach is used. However, generalising the findings of a study might be difficult in some studies, based on their context. Generalising the findings of a case study can be done through applying criteria. For example, the population

size of the case study is important, since a large number of samples will help to gather different perspectives and new opinions. A small number of participants may present one view or fail to offer enough data about the situation. The sample in this study is of a reasonable size and presents different perspectives about using PRS for teaching and learning. Moreover, the deep description required during the questionnaire and interviews may allow the findings to be generalised. When the researcher describes the issue or settings and the findings of the research, this description will help to apply the findings to the same settings in different contexts. Yin (1994) reported that if a case study was implemented according to a specific pattern, which can be implemented in another case study, then the findings can be generalised. Moreover, the quality of the case study is an essential factor that leads to generalised findings. The quality of a case study relies on constructing validity, internal validity, external validity and reliability.

This study will use a single case study approach to investigate the use of PRS at KKU. The reason for using a single case study here is because that university is the only one in Saudi Arabia that uses PRS technology. However, the use of PRS is limited in some faculties. Therefore, this approach is suitable in this study as it will concentrate and collect data from one faculty to provide an overview of the full extent of PRS use and its application. In addition, AT will be used as a framework to study how PRS is being used at KKU. This framework will offer a deeper understanding of the use of this technology and will identify any advantages or disadvantages of PRS. Following a case study approach in this study might indicate to other universities in the country how useful and practical PRS could be to them based on students' experiences in an education setting.

4.2. Grounded Theory as the qualitative analytical method

The methods used to collect and analyse data are informed by Grounded Theory (GT), which was established by Glaser and Strauss (1998). Grounded Theory was defined as a qualitative method to collect data, where that data was used to generate theory, which will help to explain phenomena and the individuals involved (Corbin & Strauss, 1990). Using GT helped to generate themes which may help to answer research questions. A theme refers to a meaning relevant to the research questions and represents a pattern of responses in the data (Braun & Clarke, 2006). Therefore, the themes were created based on repetition within the data with each participant (interviews for lecturers, group interviews with students and questionnaires) and its relation to the research questions. The themes were driven by the researcher's theoretical interests, and some pre-existing coding frames related to AT were imposed on the data, such as feelings, thoughts, behaviours and relationships. Although AT is independent from GT, the combination of these tools has offered a basis for AT to be applied to analyse the use of PRS. The data is detailed because GT was used to collect it, as it allows the researcher to return to the field to collect more data. The following section will describe the procedure for applying Grounded Theory and the approach for generating themes.

4.3. Applying Grounded Theory (GT) in research

GT is a qualitative inquiry method used to systematically examine qualitative data, leading to the generation of a theory explaining the phenomena and the individuals involved in this phenomenon. The advantage of using GT is providing a practical and fixable approach to interpret complex social phenomena (Charmaz, 2003); this approach of collecting and analysing data provides a solid

logical justification for using qualitative research to develop theoretical analysis

(Goulding, 1998). Fundamentally, GT will help provide a rigorous analysis of the data, leading to theoretical analysis (Charmaz, 2006). Therefore, GT is a pattern of analysis used to consider the data with the intention of conceptualizing it theoretically. In GT, the researcher moves back and forth between these phases to ensure the code is accurate and can be related to a category, and to increase the possibility for theories to emerge or be conceptualised. Moreover, this process will make the analysis deep and accurate as it can capture the meaning and the emotion of the participants. The analysis procedure followed a GT approach for collecting data, which involves phases related to the methodology of GT, including open coding, axial coding and selective coding (Corbin & Strauss, 1990). In addition to the coding phases, there is a theoretical writing phase during the collection and analysis of the data, called memo, which was recommended by Charmaz (2004).

4.4. Using Activity Theory in this study

As outlined in detail in the second Chapter, AT is related to the idea of mediated action (Vygotsky, 1978b). This theory gives due consideration to any mediating artefacts that could effect the learning process, hence providing an important attribute that could contribute towards a better understanding of the use of PRS in a Saudi university from the perspective of both the students and the lecturers. This assumption is further strengthened as this learning process is characterised by several factors including social, cultural and technological factors. Also, since one of the key principles of AT is the conceptualisation of learning as a social activity (Engeström, 2001), this lays a strong foundation for the research questions of the current study since it aims to tap into the social reality of the participants engaged in both learning and teaching.

The main focus of this study is to conceptualise the education environment as comprising interconnected systems of interactions, as highlighted by Engeström (2008), AT also recognises that the education environment is made up of interconnected systems of interaction which can also include the use of technology. Moreover, as described in detail in the previous chapter, AT has been used in a couple of studies to evaluate the use of technology in a learning setting. More specifically, research involving the assessment of PRS using AT is still in its infancy, but is greatly encouraged given the flexible and multi-dimensional nature of this theory. With all this in mind it is expected that the research questions of the current study will yield rich results and perhaps provide a novel insight into this topic.

4.5. Combining Activity Theory with Grounded Theory

The link between AT and GT in the current study relates to using the former as a tool to interpret the data while incorporating GT techniques to collect and analyse, code and classify the collected data. The initial observation of the data shows the importance of using grounded theory to arrive at AT. The methods used in this study are questionnaires, group interviews and individual interviews with the lecturers.

An activity system is based on the relationships between its components. One of the essential concepts of GT is its open approach, which allows for the emergence of activity systems, instead of forcing activities to appear. Allowing for activities to appear from the data is a core principle of GT as it allows participants to describe the activity and also their experience. Therefore, this allowed the in-depth analysis of the activity to help understand the use of PRS in the Saudi University. Also, given that AT comprises different levels and, more importantly,

Since these levels frequently occurred in the analysis of the collected data in this study, no qualitative data analysis approach other than GT was deemed effective and sensitive enough to capture the complexity of the interaction between these individuals and PRS technology.

Applying GT involves generating codes, combining and compiling codes into categories to form concepts, which kept the researcher in close contact with the data. These concepts were initially descriptive, but then became data ready for analysis, and this analysis was based on the concept of AT. The links between these concepts were generated based on the relationship between the components of AT. AT has expanded GT by including social and cultural factors, which were not visible in the grounded approach. Seaman (2008) also found that AT has the potential to stretch GT in various directions widening the cultural and historical context of a study and also identifying important information obtained as data from participants, which would have been unrecognised in traditional GT literature. In this case, the influence of the Saudi culture on the interaction process between the students and the lecturers in a learning environment was captured and also linked to their experience of the use of PRS to optimise learning.

According to Rivers, Calic and Tan (2009), combining AT with GT can aid in understanding two main types of interaction: human-human interaction and human-computer interaction. This is in line with the present study, whereby the combination of both theories provided a better insight into the student-lecturer interaction as well as the student/lecturer-PRS interaction. Moreover, the above authors also highlighted the complexity involved when studying and analysing these two types of interaction. As such, they proposed that combining two

qualitative approaches such as AT and GT can help to overcome the aforementioned issue; an observation also made in this study, whereby the data analysis process was carried out in less time and using fewer resources than was anticipated prior to the decision of combining both methods. However AT has also raised contradictions in the relationships between the components. This observation was also made by Kheir Abadi and Alsop (2011) who combined AT with GT when studying the learning of programming, using GT to support AT. Using GT in isolation would not allow the researcher to identify contradictions in the PRS activity.

There are three generations of AT and each is suited to the analysis of a specific situation. However, the third generation of AT was selected based on the GT analysis. Through the codes and categories generated by the GT process, much evidence supporting the third generation of AT emerged. For example, objectives for students and lecturers, their roles in the activity, and also the rules they followed in the activity. Therefore, GT might be the most appropriate approach to generate the components of the PRS activity systems and also to select the suitable generation of AT to analyse the use of PRS, as it provides a robust qualitative approach for collecting data (Kheir Abadi & Alsop, 2011). The latter authors also found that while activity theory was powerful enough to simplify complex situations, which then made them easier to analyse, GT paved the way for a flexible and open approach in relation to data collection. Furthermore, this data analysis technique also limited the number of presumptions and hypotheses which, according to the researchers, could have restricted the scope of their findings.

Combining AT and GT is the most appropriate approach to analyse PRS activity in this study. It could be argued that this research provided further empirical support for the successful combination of AT with GT based on the fact that the data analysis produced interesting and some novel findings in this under-researched area. Nevertheless, it should also be noted that given the small sample size used in this study, future research needs to further test the usefulness, validity and effectiveness of this combination with larger and more diverse samples of both students and lecturers in the Higher Education sector. Past research indeed reported that although AT and GT can contradict each other in some ways, they remain compatible in many ways (Seaman, 2008). For instance, both theories share a similar philosophical background embedded in symbolic interactionism (Batiuk & Sacks, 1981). Hence it has been argued that both are social as they emphasise the reciprocal relationship between culture and human interaction (Seaman, 2008), which is also the focus of the current study. That is, AT and GT were both useful to comprehend the social interaction occurring in the Saudi learning environment and which involved the use of technology as a mediating factor.

Taking all the above into consideration and with strong support from past research exploring the combination of AT and GT as two dominant qualitative approaches, the current study further supporting this combination.

4.6. Ideal types

The ideal type is one of methodologies has been established by Weber in the beginning of 19th century. According to Henriques (2014) the ideal type is an abstraction and Weber attempted in his ideal type to provide empirical evidence accurately

and consistently. It is a relation between the ideal concept and the available data, which might not be applied to the available data. This concept does not apply to all the individuals but represent the researcher's view of the ideal context. The concept of ideal type based on generating an ideal concept or framework of a situation, which might be not real in every aspect but can be compared to the reality (Bruun, 2012). This framework is not to evaluate the situation "good" or "bad" but to highlight different aspect of the phenomena. Additionally, the ideal type is used to capture the most important aspects of social phenomena and intensively analyse these aspects. For example, this approach was used in this study to idealise different use of the PRS for the lecturer and students with different objectives and different strategies. In this sense it is a methodology to approach the reality; this will help to capture the reality. The ideal type aimed to compare how the situation should be and how the reality is. The ideal condition will be considering every aspect of the reality.

Weber in his methodology created fictional concepts about what he was interested to look at. In this study, I am investigating the relationships between subjects (student and lecturer) and their objectives through the eye of AT. Therefore I have generated an ideal activity system to describe how the situation should be and the ideal use of the system compering to the available data. The available data has showed different improvements and negatives of the use of the PRS in the education context. These improvements will match the ideal framework of the PRS. On the other hand, the negative aspect of using the PRS will not match the ideal framework for the PRS activity. In this process, the implication of the PRS on the educational context will be clarified and abstracted to see constrains in the PRS activity systems for student and lecturer.

5. Data collection methods

Using a case study approach allows the use of different instruments to collect data. However, the case study approach is usually used to understand the situation and should have deeper details about it. Therefore, the case study approach mostly relies on qualitative data, rather than quantitative data (Hayes, 2006). Applying qualitative methods will lead to looking beyond the activity structure to the relationship between the factors in PRS activities. Moreover, qualitative methods will help respondents to give their opinions and thoughts without limiting themselves to a specific answer. There are different kinds of qualitative methods: questionnaires, interviews and observation. This study will use all three types of research methods in order to gather data from different perspectives and to support the findings from each method.

5.1. Interview

It is widely observed that the interview method is used to gather information about people, places, or situations. The main reason for using the interview is to understand how respondents feel or think. Moreover, it allows the researcher to recognise the meaning given by interviewees in reference to their behaviour and in ascertaining their motives and intentions, since the interview gives the opportunity for a long and detailed answer (Creswell, 2013).

The semi-structured interview was used with lecturers to understand the relationship between the components of the PRS activity through their responses. This type of interview was chosen to better understand the relationships in the activity, since it is possible to create questions during the interview to obtain rich information. Moreover, it offers more flexibility to talk about different aspects or only one aspect of a question, in line with the nature of the paradigms and

research approach of the current study, as supported by previous qualitative interpretivist research (Herrett *et al.*, 2010). In this form of interview, the interviewee might be more encouraged to communicate with the interviewer, hence yielding richer and more detailed responses. It has been previously reported that semi-structured interviews are indeed useful if detailed information is required on a novel topic with a very small sample, but still enough to produce rich data (Plaisant & Shneiderman, 2005). Since the current study is also investigating a new topic in as much detail as possible but only limited participants were available, this last advantage is certainly important.

Closed demographic (relating to age, experience, and background) questions were designed to put directly to the lecturers. An example of these questions is “How long have you been teaching in Higher Education?”. There were four questions of this type at the beginning of the interview. These types of questions were avoided in the rest of the interview schedule to allow participants to express their feelings, experience, and thoughts about the use of PRS in the context of Saudi Higher Education. The questions in the interview mainly seek to identify the influences of using PRS in teaching, the relationships between the lecturer and his students, and between them and other components of the activity to transform the objective into a successful outcome. Examples of some of the interview questions are: "How do you think using PRS for lecturing will influence the relationship between you and the students?" Asking such a question has provided details about PRS as a mediating tool to increase interactivity and the roles in PRS activity. Another question was "Do you think the rules of PRS activity are influencing the way to reach the objectives of the activity?" This question was formulated to understand the relationship between the rules and the objectives.

The interview schedule included 12 questions, excluding the additional demographic questions.

5.2. Group interview

The group interview is a form of a research method used to gather qualitative data from a group of individuals by the researcher. Basically, the data is gathered from individuals and represents their opinions, conceptions or experiences about the situation, idea or product. Fundamentally, the questions are asked in the form of an interactive group setting, which allows more freedom for the participants to talk and give their thoughts. The main difference between the focus group and the interviewing group is the interaction in the focus group, which should be provided by the researcher (Morgan, 1997). Therefore, in this type of research method, the data is collected through interaction with the participants.

The purpose of using this method is the potential to draw upon the respondents' experience, behaviour, beliefs and reactions, which might be not available in other research methods. In other words, participants in social settings (group interviews) might feel more independent and freer to act naturally, and hence reveal more details through interaction (Creswell, 2014). The recommended number of participants in one group is between six and ten (MacIntosh, 1993), which allows the researcher to control a meeting, ask questions and interact with the participants. The number of participants in both groups was 20 participants, with 10 participants in each group. Each participant was given an identifying number and each interview, and their responses were recorded in order, based on these numbers. Moreover, the group interview can be used once, or more than once, with the same group or a different group. The group interview meetings lasted between an hour and two hours. In this study, the group interview method

was used to collect data about the use of PRS and the relationships between PRS activity components in a social context from the students' perspective. Furthermore, the data from the group interview was used to support the findings from the questionnaire. Additionally, the findings from the group interview have provided a new perspective or different ideas, since participants are free to talk. Examples of group interview questions are: "How do you (as a user) see the influence of the Personal Response System to reach your goal of attending the lecture?" This question has provided information about the relationship between the user (subject) and the mediation tool (PRS). Moreover, in this question we can draw on the affordance and the constraints of using the tool. Another question was "Do you think the roles of individuals in PRS activity influenced your participation?" This question was asked to understand the relationship between the community and the division of labour.

Overall, group interviewing was specifically chosen with the aim of recognising the complexity of the educational, social and cultural setting of the participants, which also involves language as a mediating tool. As such, it could be argued that this technique finds support from AT, the theoretical framework guiding the current research.

5.3. Questionnaire

The questionnaire is a research tool containing a series of questions about specific topics or issues used to gather data from participants. Questionnaires are widely used in social and educational research and are often used together with interviews (Blaxter, Hughes & Tight, 2010). Although the questionnaire is mostly designed to gather statistical data, this method can also be used to collect qualitative data, in the form of a semi-structured questionnaire.

The questionnaire has several advantages over other types of research methods. The questionnaire has standardised answers, for example, multiple choice questions or using Likert scale based open-ended questions. However, these questions should be formulated carefully to make sure that the participants are not influenced by them. In general, the types of questions used in this form of research method are open-ended and closed-ended questions. Open-ended questions allow the participant to formulate her/his answer, whereas closed-ended questions prompt a participant to select a specific answer from the given answers. The semi-structured questionnaire is increasingly used in research nowadays given that its mixed format makes it more adaptable to different contexts, especially when exploring people's attitudes (Desai & Potter, 2006). As such, its suitability in investigating the teaching and learning process using PRS in a Saudi context is worth noting.

In the present study, the researcher accurately designed the questionnaire to ensure the sequence of questions was logical. Moreover, the questionnaire was designed to fulfil the purpose of using them to collect data and answer the research questions. Therefore, the questionnaire was selected to gather data about the students' experience. In fact, it was anticipated that the questionnaire would help to understand the relationships between the factors effecting the PRS activity, and the findings will feed into the group interview. Open-ended questions allow for more data collection and consider different perspectives compared to group interviews. In addition, it was expected that some students would feel freer to respond to the questionnaire than talking face-to-face in the group interview. Examples of questions in the questionnaire are: "Using the Personal Response System increases the interaction between me and the lecturer and other students more than in traditional classes", with responses ranging from 'strongly agree', to

‘agree’, to ‘neutral’, to ‘disagree’ and ‘strongly disagree’. This type of question was created to assess the students’ experience of using PRS technology, and if using PRS makes any difference to learning as opposed to traditional classes. Another question was “How do you think the rules for using PRS (time, type of questions and the way of answering questions collectively or individually) influenced your learning?”. This question was asked to understand the relationship between the students and the rules of the activity, and how these rules mediate between a student and other individuals in the community. The semi-structured questionnaire is effective method as it allows participants to describe a situation in their own words (Morse & Field, 1995), helping the present study access as much rich data as possible.

6. Validity and reliability of the case study approach

This study used a case study qualitative approach and adopt a social constructionist research paradigm. In research, the constructionists believe participants have different perceptions of a given phenomenon, where different individuals might interpret their views differently. Their views are socially constructed, based on their past experiences and interactions, which form their view on the phenomenon under examination. This study has adopted different data gathering tools (interviews, group interview and questionnaire) to answer the research questions, hence it is essential to test the validity and reliability of such tools and the constructionist study as a whole (Cohen, Manion & Morrison, 2013). Validity is generally associated with the extent to which the research tools used are consistent with the aims of the study, while the reliability reflects the consistency in answers across the tools used (the extent to which items/questions/tools measure for the same thing). One of the core principals of constructionist research is to seek different perspectives as a given reality and

probe for a deeper understanding and not merely abstract features (Johnson, 1995).

Essentially, using different data gathering tools provides the researcher with different and more detailed information while validating outcomes from different sources and increasing reliability. In the qualitative research there is no fixed or single definition for validity and reliability, but it relies on the research methodology for each study and how researchers see the validity and reliability for his/her research (Golafshani, 2003). To test the validity in this study I will focus on trustworthiness (internal validity) and confidence (external validity), while aspects of consistency (reliability) will reflect the reliability of this study. These terms cover qualitative validity and reliability, so achieving validity will lead to reliability (Golafshani, 2003).

6.1. Trustworthiness and confidence

In qualitative constructionist research trustworthiness (credibility) is the approval of the research as a representation of the reality of different meanings by the participants in the study or experts from the same field and context as the study (Riege, 2003). The justification of using this type of validity is to show that the research was carried out using an appropriate methodology to create credible findings. In order to increase the trustworthiness (internal validity) in the current study, I applied two processes. The first step is using crystallization techniques by applying multiple sources of evidences (Ellingson, 2009; Riege, 2003). Three methods were used in this study: interviews, group interviews and a semi-structured questionnaire. The second step is using a debriefing technique by allowing a colleague or expert to go through the research in a critical way to ensure trustworthiness (Robson, 1993). Moreover, presenting the findings and

conclusion to experts to make comments and recommendation into consideration during the process of writing the report will increase the credibility of the study (Lincoln & Guba, 1985). In this study the participants will be asked to review the findings to make sure they represent their perception of using PRS for teaching and learning. In order to achieve this type of validity, experts and colleagues in educational technology from Saudi Arabia, from Plymouth University and the University of Exeter were asked to review the methodology and findings to confirm the credibility of the research. Some comments about the methodology and findings were taken into consideration. Additionally, the participants were asked to review the findings to make sure they represent what they think, and some comments resulted from this.

To ensure that this study is externally valid confidence in the qualitative methods used will be established. This is achieved by describing the research phenomena in great detail, to the extent that one can be confident that the results describe the social situation (Lincoln & Guba, 1985). Riege (2003) calls this “analytical generalisation”. Over the course of the research, details of the research methodology will be provided to allow the reader to understand the social situation under examination (Lincoln & Guba, 1985). Details were included about the analytical methods used while explaining the relationship between the elements of the PRS activity and using Grounded Theory for collecting and analysing data. These codes or themes can be commonly used in other cases with clear instructions e.g. explaining the relationship between students and lecturers, the relationship between students and their peers, and the relationship between students and PRS.

6.2. Consistency

The third type of validity is consistency (reliability) i.e. having consistent procedures during the research and in the findings of the research. Therefore, this type of validity refers to the consistency and stability of the methodology chosen for the research. To examine the reliability, the richness of the data, the reduction of data and the data processing must be assessed (Campbell, 1997). In order to achieve consistency in the current study, the researcher met with the supervision team continually to make sure the correct methodological decisions were taken; this is supported by Riege (2003) as form of increasing the consistency (or dependability) by allowing colleagues to review the methodology. Additionally, using electronic tools to record interviews and group interviews will increase the reliability of the data (Riege, 2003). This was achieved in the current study, where a data recorder was used to record the interviews. Moreover, the parallelism (using different processes in parallel) of findings from different methods must be meaningful and lead to the same result (Yin, 1994). This was achieved through identifying similar meanings for the findings from the interviews for the lecturers and the group interviews for the students to support the evidence. Taking into consideration every step of the research and applying theories and ideas will increase the reliability (Yin, 1994). For example, here GT was used for collecting and analysing the data, and all phases of the GT were applied to ensure reliable findings were achieved. There was correspondence between the phases of the GT and the process of collecting and analysing the data.

6.3. The validity of the interviews

Basically, the validity of the interviews refers to whether the questions measure what they intend to measure. One of the causes for invalidity is bias, which is “a systematic or persistent tendency to make errors in the same direction, that is, to overstate or understate the true value of an attribute” (Cohen, Manion & Morrison, 2000). In order to achieve significant validity for the interview method, bias must be reduced. The biases in the interview method come from the characteristics for the interviewer and respondent, the content of the interview and how the questions are formulated. The formulation of the questions should consider: attitude, opinions and expectations of interviewer.

In order to avoid any bias in the interview and achieve greater validity, I tried to ask clear questions to allow participants to understand and answer more easily. The clarity of the questions will help participants to show their natural attitudes and expectations of the interview. Moreover, the researcher tried to avoid leading questions to give participants the opportunity to express their opinions. Additionally, the researcher physically attended the interviews to observe the participants’ expressions and feelings about the questions. Generally, the questions were formulated to be clear and to avoid misunderstandings, which may affect the validity of the interview.

6.4. The validity of the group interviews

The group interview is like other social research methods to collect data; its validity relies on the means of conducting the interview and the suitability for using this method in a specific context. By constructing a social space for generating data, it is likely that the data will represent that found in other, similar social spaces, such as classrooms. The unstructured technique was used to allow

discussion between students and the researcher. The questions were generated to examine various aspects of using PRS, with the possibility to generate discussion by asking questions. The disadvantage of group interviews, which may effect the validity of this method, is that students may not give accurate answers in front of other students. To avoid this, the researcher tried to ask general questions at the beginning about each aspect and after that ask for more clarification and examples from the students in a friendly manner to increase honest interaction. In some cases, the students steered the discussion to another topic, but the researcher asked questions to get the students back on topic. Additionally, some students tried to dominate the discussion, but the researcher took quick action to allow all the students to contribute to the discussion.

Moreover, the students were informed about the privacy of their answers and the way data will be treated during and after this study. That allowed more opportunities for the students to talk and give their opinion about every aspect of the PRS activity. The students were asked to not identify themselves while they were talking, to boost their confidence and talk naturally, which encouraged them to engage in the group interviews.

6.5. The validity of the questionnaire

In this study the researcher used a semi-structured questionnaire which included open-ended and closed-ended questions. In order to achieve greater validity, I tried to obtain the participants' consent through distributing a form containing information about the research project prior to filling out the questionnaire. Additionally, the form clarified the confidentiality and privacy information, relating to how identity data would be treated. The form stressed the importance of their participation and the confidentiality of their responses, since the questionnaire

was anonymous. This has increased the validity of the questionnaire. Additionally, the researcher attempted to craft clear and non-sensitive questions to allow students to answer without doubt the questions. The researcher used demographic questions to understand the nature of the sample. The number of participants was reasonable to address the validity and reliability for the questionnaire.

7. Researcher positionality

Research can be called research when a written report is published for the public (Stenhouse, 1975). Social research is not conducted in isolation from the people who identify with that issue, create methods in which to understand it and produce the outcomes or the solution. In fact, positionality can play an important role in designing valuable research and an efficient research process. Fundamentally, bias is not acceptable in any form of research used to achieve reliable and accurate results. However, a researcher must have a lot of knowledge about the topic under investigation; this will not necessarily influence the results. The researcher should provide the findings as they are, without any outside influence.

The researcher's position has been examined in many studies. The researcher can have an external or internal position and either position can be seen positively or negatively (Kelly, 2014). In other words, the insider position may offer an accurate view of the situation but may generate a dominant perspective. The outsider position is helpful to create new perspectives; however it might produce a generic view, which does not suit the situation. Therefore, it is effective to have both positions to generate a more balanced view. Having both positions should contribute to the results of the research. The extent of each position should be explained instead of using both without limitations. The relationship

between the participants, the institute and the researcher will be that of an outsider, since the researcher is not related to the university. This is necessary to avoid influencing participants' perspectives. The relationship between the research and the researcher will be an insider perspective, since the researcher has expertise and experience in this field of research, and work experience for the Ministry of Education in Saudi Arabia. This pattern of position will contribute to a valid research study and reduces the risk of bias. Therefore, the researcher from this position of being an insider can assess participant behaviour and the collected data neutrally.

On the other hand, the degree of objectivity will be high since the researcher takes on an outsider position. The researcher will engage with this position at different stages of the research process by selecting the method of research, interviewing participants and in reflection, during the writing up of the thesis. The researcher has selected the research methods based on their position and they are mainly qualitative. These will be carefully designed to avoid any influence on the participants' perspective from previous experience or understanding the context. Moreover, analysing the data and writing the report should not include any biases.

8. The data collection procedure

The data was collected from students and lecturers at King Khalid University (KKU). Overall, the duration for data collection was a whole semester, from February to June 2014. Some interviews were conducted during the semester, but many lecturers were interviewed at the end of the semester. The duration of each interview was between 45 minutes and 1 hour 8 minutes. The interviews were conducted in Arabic and subsequently translated in English.

The group interview was conducted with 21 students for two groups. The first group involved 10 students from the nursing course and lasted for 1 hour and 28 minutes. The second group involved 11 students from the medical course and lasted for 1 hour and 42 minutes. In both group interviews, all the students participated and gave their opinions for all the questions. Moreover, some additional questions were used to obtain more information about their learning experience using PRS.

The questionnaire was distributed at the end of the semester to collect all the data regarding the students' experience of using this technology. Questionnaires were distributed to 80 students in both courses (medical students and nursing students) at the end of the spring term, 2014. It would have been more effective if the researcher had distributed questionnaires both before and after the course, but there was no opportunity to do so due to the students' low attendance and their difficulties using the system at the beginning of the term. The percentage of completed questionnaires is 96% (76 students). The rest of questionnaires (4%) were not returned by the participants. All the students answered the closed-ended questions but not all of them answered the open-ended questions and some gave short answers, which was insufficient to properly represent their opinions. Therefore, these answers were classified as incomplete and were not included in the analysis. The lecturers were interviewed both during and at the end of the semester. The following diagram shows the methodology for this study and procedure for collecting and analysing data.

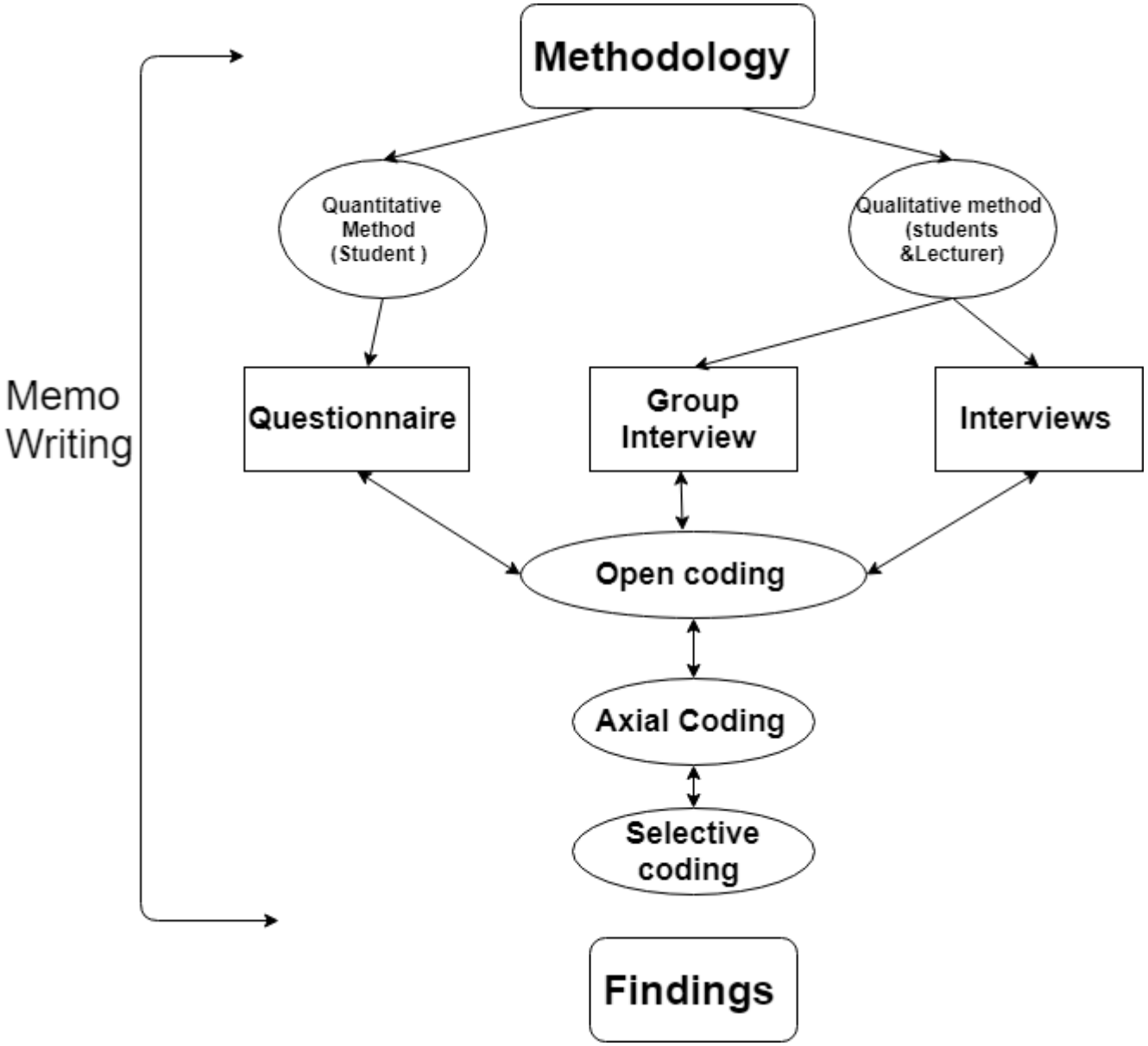

Figure 9: the stages of the methodology

8.1. Sample

The data was collected from more than one group of students, but mainly at the medical school and during 9 lectures. PRS is a new technology for teaching and learning in Saudi universities. There were attempts to contact many universities

to collect data from different universities in the Saudi context. The researcher phoned, emailed and visited some universities (King Saud University, Kind Abdul Aziz University, Umm Alqura University and other universities). Nevertheless, PRS was not available for teaching in these universities, though some use the system for training and conferences. The only university using PRS for teaching and learning in Saudi Arabia at the time data was collected was King Khalid University. The university introduced PRS in 2010 and it has been used in the medical school ever since. The system was used by some lecturers, but others have never used it. Both lecturers are teaching biology, biochemistry, applied and clinical immunology, introduction to clinical ethics (ICE) and other modules.

Therefore, the research was conducted at the medical school to investigate the effectiveness of PRS use at KKU. Only 4 lecturers had experience in using this technology, as they have been using this technology since it was introduced. In order to get more lecturers involved in the study, workshops were offered to those lecturers who wanted to use the system but had no experience. After the workshops, 5 more lecturers showed their interest in engaging with the study. In total, 9 lecturers were involved in the study, 4 of whom had previous experience of using this technology and 5 of whom had not used PRS before the study. The lecturers who had no experience of using PRS were offered training on how to use it.

Approval from the university was obtained to collect data from two groups of students. The first group involved 26 nursing students in the second year of their degree. The second group involved 54 medicine students in the third year of their degree. The average student age was between 20 and 26 years old. The study was conducted in the male section of the university, so all the participants

(lecturers and students) were male. This is because the education system in Saudi Arabia segregates males from females, as it explained in the literature review. Therefore, the researcher did not have access to the female section. In addition, all the participants are from the same region (South of Saudi Arabia, where the university is), except three lecturers, who were non-Saudi but speak Arabic.

8.2. Data analysis process using Grounded Theory

The following section describes the procedure used which was informed by Grounded Theory as the data analysis tool in the current study. The following diagram shows the methodology steps to collect and analyse the data.

8.2.1. Memo writing

This phase is a vital step between collecting data and generating theory or findings (Charmaz, 2006), which started at an early stage of the research process (Corbin & Strauss, 1990). In this research, the memo was kept as a note to the researcher and the decision to create codes and categories was supported by the notes in the memo. Moreover, generating the categories and the relationships between these categories was supported by the thoughts in the memo. These thoughts were recorded, handwritten, as and when they occurred. Generally, it provided an effective guide for the researcher during the analysis phase. The process of memo writing followed strategies suggested by Charmaz (2006). This enabled the researcher to follow the process of collecting and analysing data. Therefore, the researcher wrote notes during every stage of this study about collecting data, coding, creating categories and the level of selective data to generate theory.

8.2.2. Open coding

This phase is the initial step towards analysing the data, where data is highlighted or assigned labels in order to identify categories. The initial codes appear close to the meaning of the data or sometimes use similar words as appear in the data. For example, increase participation, distraction and so on. Open codes were generated whilst re-reading interview transcripts, listening to the recorded interviews and reading the data from the questionnaire. This approach will facilitate understanding of the meaning of the data and clarify it during successive readings. Generally, the codes were descriptive, reflecting an understanding of the data and some were phrases taken from participants' responses. During the process of open coding the researcher revisited the research questions to select the most important actions, emotion and incidents, which may help to answer the research questions (Corbin & Strauss, 1990).

The words were examined closely to identify hidden meanings in the dialogue relating to the research questions, which was achieved by asking some questions during coding. These questions included, 'what does this mean?' or 'what is going on here?'. This led to some parts of the text receiving multiple codes. For example, students reported "The lecturer was able to ascertain our level of understanding, if we understood the concepts or not by using the PRS and showing the result". This response is an indication of a stronger relationship between the lecturer and students, created by using the PRS, as the lecturer uable to measure the students' understanding. At the same time, the lecturer was able to assess students understanding.

Initially, the data from all the research methods were collected in Arabic. Then the data was transcribed in Arabic and later accurately translated into English.

Throughout transcribing and translating the data, the meaning and emotion behind particular words was retained. The codes generated refer to events, actions and emotions and were understood as indicators of the relationships in the PRS activity and influences of this technology on students. These codes were grouped together to create a category. The codes referring to PRS activity were compared with the codes referring to traditional lectures. This was done to capture changes brought about by introducing PRS to lectures.

8.2.3. Axial coding

The second phase of GT is axial coding, grouping labelled concepts, actions or events and finding the connections between them (Corbin & Strauss, 1990). This process involved focusing on three aspects of the activity: the conditions and situations in which the activity occurs, actions and interactions between participants as reactions to the use of the PRS technology and its rules, and the influences of the activity and its situation (Corbin & Strauss, 1990). The identification of these categories began during the process of coding; the category evolved as coding progressed and relationships were identified. In this study the categories were generated based on the codes and the research questions. In other words, codes referring to the relationships between the components of PRS activity were selected and grouped under a specific relationship. For example, a category was generated under the name, 'relationship between the lecturer and students' and the codes under this category all relate to this relationship. In axial coding, grouping the codes relies on asking Strauss and Corbin's questions (1998): "*when, where, why, who, how and with what consequences*" of any category. Answering these questions helps to link the codes together and find the rationale for grouping codes under a

specific category. The example below shows how codes were grouped under the category of understanding.

For example, student 8 indicated that the PRS, generally, helped him to increase his understanding, and that answered the question 'What is the influence of the PRS?'

> "*Using the PRS technology **helped us to understand** the content deeply compared with the traditional lecture. When we use the system we can learn new terms through answering the PRS questions*".

Student 3 clarified the method of understanding, which illustrates how understanding can be achieved through using PRS.

> "*In the traditional lecture, it was difficult for us to understand, because we did not know the meaning for many terms and it was not easy to ask about them, but by reading the PRS questions and asking other students or the lecturer **I can understand the meaning of many concepts***".

Axial coding has facilitated the identification of the relationships between the components of the PRS activity, the influences on student experiences and the implications for the educational environment. Generally, the relationships between the PRS components were chosen to illustrate changes to the relationships in lectures following the introduction of PRS. For example, the relationships between the lecturer and students, between the students themselves, the students and their roles and so on.

The relationship between students has been chosen as a category, and there are codes illustrating the forms of these relationships in PRS activity.

For example, student 11 reported the relationship between their classmates and a cooperation to learn, which generated the code for this text, “cooperation”.

> “*I could learn from other student during the activity more than the lecturer, through* ***asking other students about the answer for a question and how he chose the right answer, and he can justify*** *that. For me it’s easier to ask other students than asking the lecturer*”.

Another form of relationship was coded as competition between students.

For example, student 10 reported the following:

“*There is a kind of* ***competition*** *when we use the PRS because every student wants to choose the right answer. I feel that is a motivation factor for me to concentrate and not miss any information because I want all my answers to be right, along with the other students who chose the right one*”.

Another relationship was coded as collective learning (cooperative learning), as the students worked as a group to answer the questions. For example, student 9 reported the following:

> “***Using the PRS within a group*** *is more beneficial than using it individually, as I can understand the meaning of the question because some terms are difficult and together we learn more*”.

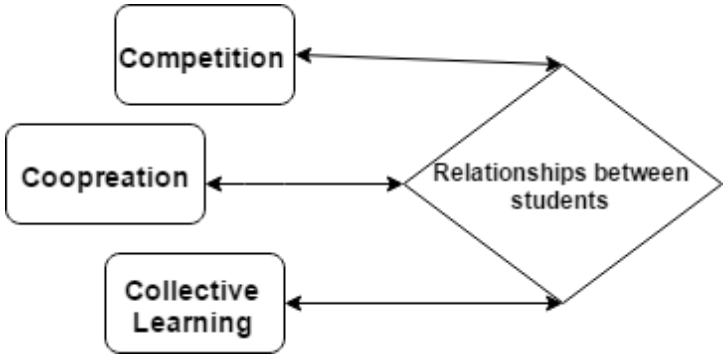

Figure 10 Example of coding

Understanding the conditions for relationships and how these conditions might affect them has helped to identify the connection between this category and other categories. Axial coding has facilitated the exploration of actions and strategies for the participants to use PRS. As this process progressed, more categories came to light, enabling the generation of a theory. Moreover, there is a greater possibility of finding relationships between the categories in this phase.

8.2.4. Selective coding

This phase is the highest level of data analysis in GT, which involves identifying the major themes grouping the categories. At this phase the researcher will be able to generate a theory from the data (Strauss & Corbin, 1998), or start the theoretical analysis. The major themes in the study emerge from grouping the categories and are related directly to these categories and illustrate the relationship between them. The categories generated in this study refer to the relationships in PRS activity. For example, relationships between students, the relationship between the lecturer and the students, the relationship between student and his role and other categories. These categories have constituted the major theme, which has appeared in the data in different ways. The data was fully analysed and a theoretical basis has been identified. Therefore, the theory was

refined based on the relationships between the categories, the categories themselves and the major themes.

8.2.5. Ethical considerations

Ethical approval was obtained from the university in order to collect data from both the students and lecturers. The study followed strict ethical guidelines, in line with Plymouth University's research standards. Before conducting the interviews and administering the questionnaires, all participants were given an information sheet outlining the aims and objectives of the study. It was also emphasised that the data collection process would be strictly anonymous (no identifying information will be used), and only the researcher and the thesis supervisor would have access to the data collected. Participants were also reassured that all their data would be kept strictly confidential in password protected computers. It was also stated by the researcher that participants would be allowed to withdraw at any time during the data collection process without the need to provide explanation.

9. Summary of the chapter

Throughout the chapter, the methodology and the methods used for the project were presented and discussed. The chapter started with the research design to demonstrate the structure of the research and how it was implemented. The appropriation for using this methodology and method was the constructivist paradigm. Following that the process for collecting the data was explained. The choice of analysis was informed by explaining GT and the procedure for using this approach for collecting and analysing data. The framework was illustrated by explaining AT and the purpose of using this theory as method to analyse the use of PRS. Moreover, the justification for combining GT and AT

was illustrated in this chapter. Additionally, in this chapter the researcher described the methods used and the justification for using these methods. The validity of the research methods was established. The procedures of conducting this research were explained with giving examples from the data collection and analysing the data. In the next chapter, I am going to analyse and present the data from the questionnaire.

Chapter 5: Quantitative Findings

1. Introduction

This study was conducted to investigate the use of the Personal Responses System (PRS) and to understand the effectiveness of this technology among Saudi students in Higher Education (universities). For the purposes of this study, Activity Theory (AT) was selected as a framework to develop a full understanding of the process of using PRS by combining qualitative and quantitative methods. AT is deemed suitable for this study as it is a systematic approach to study technologies as tool for learning and the concept of learning as a joint activity (Engeström, 1993). Through the lens of AT, learning is a social phenomenon and the social analysis of educational activities can be carried out, from which their veracity can be ascertained.

According to AT and in line with Vygotskian analyses, PRS is used as a mediating artefact in a learning activity to facilitate the achievement of learning objectives by the users (teacher and students). Furthermore, this theory will help build an understanding of the relationships between the components of the PRS activity in the educational environment. In this chapter, the findings from the questionnaire will be presented and discussed. Data from the questionnaire were collected and coded using Microsoft Excel. The data were then analysed for descriptive statistics such as frequency, percentage and means. The purpose of the questionnaire is to provide descriptive statistics, which will support the findings from the qualitative methods. As such, they are consistent with the interpretive and constructionist stance adopted in this study.

The questions in the questionnaire focused on the relationships between students, other students and their lecture. Moreover, the questions covered the students' experience of using PRS. Although this study was based on a

qualitative approach, the findings from the questionnaire were presented statistically in order to support this data. As no process of statistical analysis has been undertaken, these statistics are descriptive only. Throughout this chapter the agreement and disagreement between each item in the questionnaire and the purpose of the questions will be shown. All the items attempt to identify the relationships between the elements in the PRS activity and discover the learning experience for the students. The questionnaires were distributed to 80 students, 76 of whom completed them. All the participants are male students from the Medical School at King Khalid University, aged between 20 to 26 years old. Therefore, the research is supported by the data from the questionnaire, which underpinned the qualitative data, as explained in the methodology (Chapter 4). These data show the findings related to relationships between students and lecturers, learning, participation, interaction, feedback and anonymity.

2. Changes in student's roles in their own learning

From the data generated by the questionnaire, it can be seen that the students prefer to answer PRS questions before they become involved in group discussions.

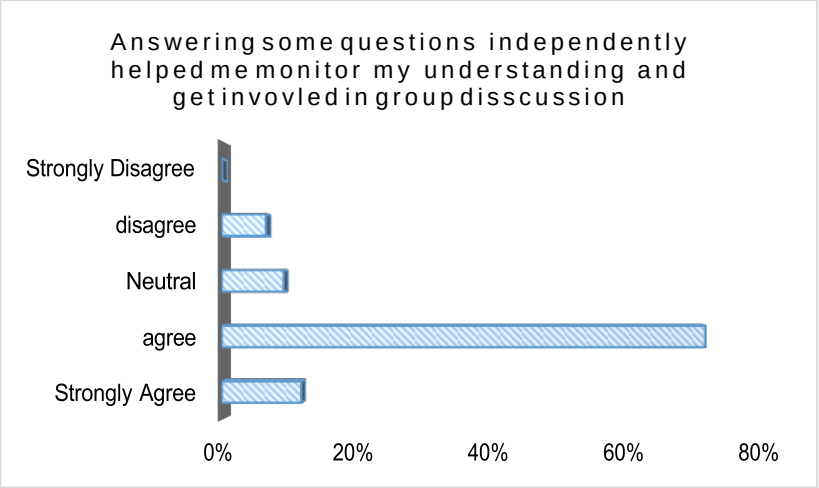

Figure 11 Independence in answering questions

Table 1. Independence in answering questions

Item	Number of Students	Percentage
SA	9	11.8%
A	55	72.36%
N	7	9.2%
D	5	6.5%
SD	0	0%
Total	76	100%

The above chart and table suggest it is important for students to answer the questions independently and offer discussion after each question, reflecting one method of PRS use. Clearly, more than 80% of the students suggest answering the question individually using PRS is helpful. This may be because they will have more chance to think before joining discussions to evaluate their prior knowledge and construct new knowledge. Less than 7% of participants disagree, believing their involvement in group discussion is more helpful. It is possible they will be able to measure their understanding with the group and better understand the content. All the students suggest the group discussion is important for their learning, but there is greater preference to have discussion after answering the questions.

3. Showing the results and impact on student relationships

Showing the answers for the students as a rule of the activity may help to understand how they think and gain an indication of what seems to be the popular answer even if the answer was incorrect. The lecturer can give more explanation and the students can measure their understanding.

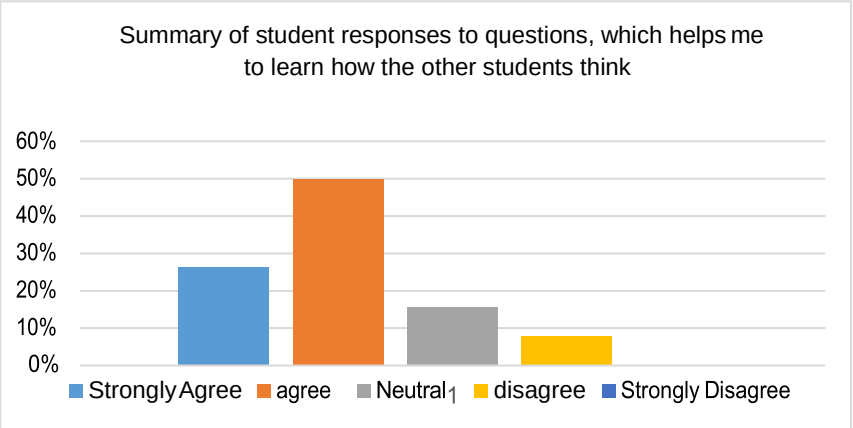

Figure 12 Learning from peers

Table 2. Learning from peers

Item	Number of Students	Percentage
SA	20	26.31%
A	38	50%
N	12	15.78%
D	6	7.89%
SD	0	0%
Total	76	100%

The bar chart and the table (2) above show that students say they learn from other students' responses, which is normally displayed in a histogram after each question. Around 78% of the students think they can learn from this and how other students think. Having discussions after each question is one of the rules the lecturers were applying in their PRS based lectures. The discussion may be facilitated by showing the answers from the students.

4. Having group discussions after each question

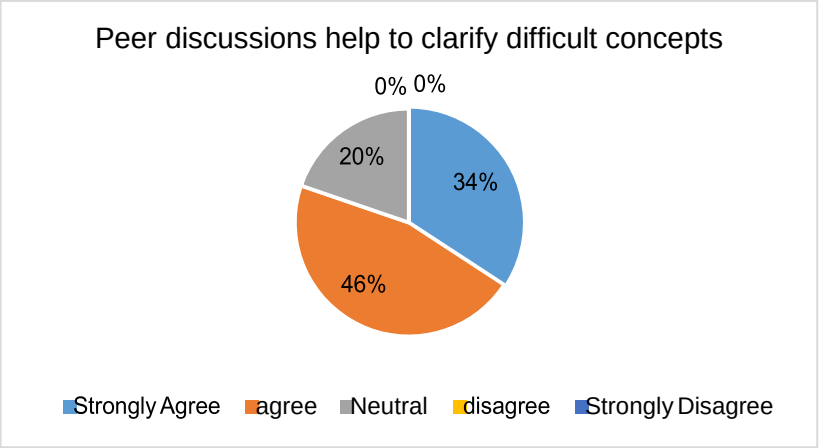

Figure 13 Peer discussions help to clarify difficult concepts

Table 2. Peer discussion helps to clarify difficult concepts

Item	Number of Student	Percentage
SA	26	34.21%
A	35	46.05%
N	15	19.73%
D	0	0%
SD	0	0%
Total	76	100%

The above pie chart and table 3 show the importance of discussion after each question. The majority of students (around 80%) suggest that having discussion after each question is an essential factor in constructing their understanding and achieving their objectives. It can be summarised that having discussions is an important part of PRS to achieve the objectives of the PRS activity increasing understanding. This result is supported by social constructivism which suggests interaction with other individuals is important to increasing understanding and knowledge building (Vygotsky, 1978a). Further, there is no disagreement with this statement; however, 15 students responded neutrally. This might be an indication that some students do not see this strategy as helpful.

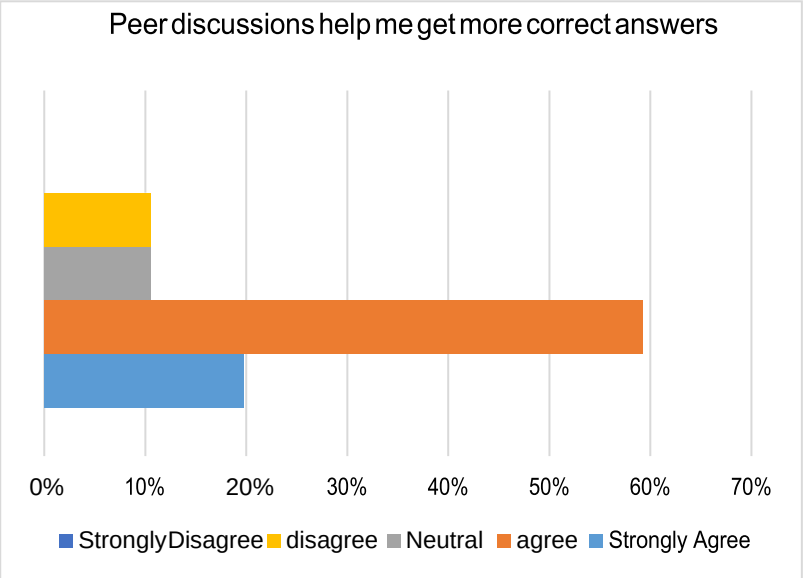

Figure 14 Peer discussions help me get more correct answers

Table 3. Peer discussions help me get more correct answers

Item	Number of Students	Percentage
SA	15	19.74%
A	45	59.22%
N	8	10.52%
D	8	10.52%
SD	0	0%
Total	76	100%

The above chart and table show the importance respondents give peer discussion for answering and understanding questions, where students can learn from their peers. More than 80% of participants stated that they get more answers correct with peer discussion. That will allow them to think differently in lectures; differently here refers to different ways of thinking for each student and how allowing discussion may help students to learn new ways of thinking. This has the potential to change the students' perceptions of the relationship between them during the learning activity. A small percentage of the participants (10.5%) disagree with this statement. The reasons for this disagreement may be because

other students in the group were not cooperative, an issue that was raised in the qualitative data. This was reported in the group interview, where students and some lecturers noted that if some members of the class were reluctant to cooperate it could have a negative effect on any benefits from the discussion.

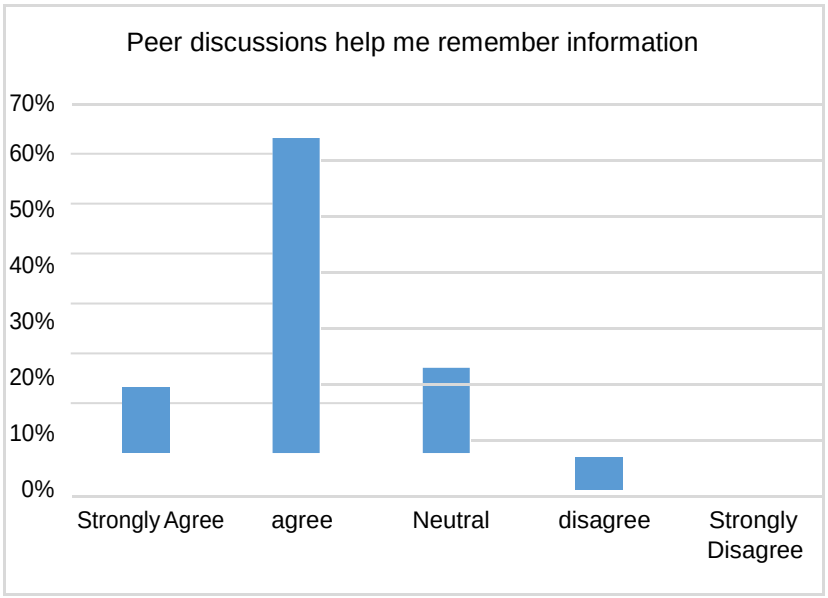

Figure 15 Peer discussion help me remember information

Table 4. Peer discussions help me remember information

Item	Number of Students	Percentage
SA	10	13.15%
A	48	63.15%
N	13	17.10%
D	5	6.57%
SD	0	0%
Total	76	100%

Additionally, the charts above show that around 76% of participants agree that discussion after each question helps them to remember the information they are being asked about. On the other hand, around 6% of the participants disagree.

This may be because they use different strategies to increase their knowledge retention. It was found in the group interviews that some students rely on memorising information they get in the lectures to succeed.

5. Increasing participation

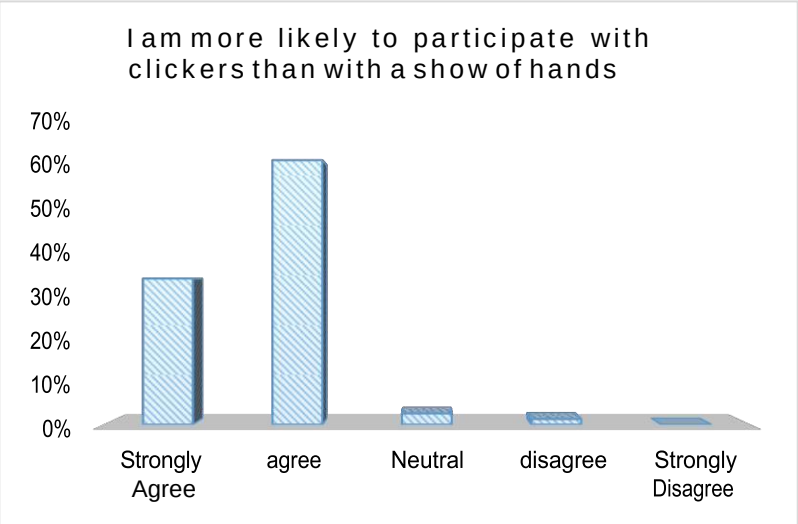

Figure 16 I am more likely to participate with clickers than with a show of hands

Table 5. I am more likely to participate with clickers than with a show of hands

Item	Number of Students	Percentage
SA	26	34.21%
A	47	61.84%
N	2	2.6%
D	1	1.31%
SD	0	0%
Total	76	100%

The above chart and Table 6 clearly show how the system has increased participation in lectures for students. Almost 96% of participants agree that PRS increases their opportunities to participate in comparison to the old style of lectures. Thus, PRS is a vital motivational tool for student participation. The PRS

has changed both the relationship between the lecturer and students and the relationship between the students, wherein they are more confident and more willing to participate. Only one student disagreed with this. He felt there were more possibilities to participate without PRS. This might be because he had the confidence to answer the questions verbally in the traditional lecture, whereas in the PRS lecture everyone else was able to participate.

6. Explaining concepts to other students

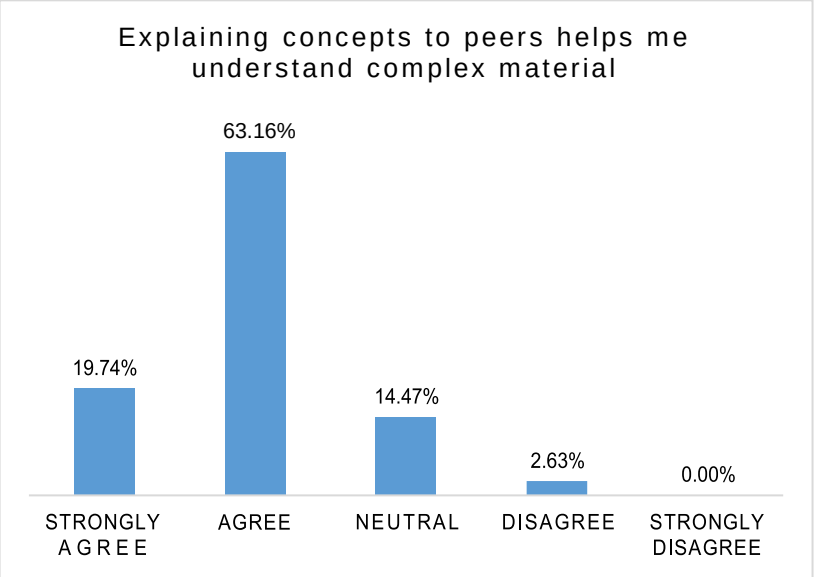

Figure 17 Explaining concepts to peers helps me understand complex material

Table 6. Explaining concepts to peers helps me understand complex material

Item	Number of Students	Percentage
SA	15	19.73%
A	48	63.15%
N	11	14.47%
D	2	2.63%
SD	0	0%
Total	76	%100

The above chart shows how students who explain their answer to other students during the lecture and after using PRS benefit from this interaction. It can be seen that around 83% of the participants agree with this statement, that through

explaining things to their peers they become more confident and able to understand complex materials. This is possibly because the act of explaining something forces them to think more deeply about what they are going to say, how they organise the information and how it links to other information. This shows how the relationships between the students are important to improving their learning. Two students disagreed with this statement.

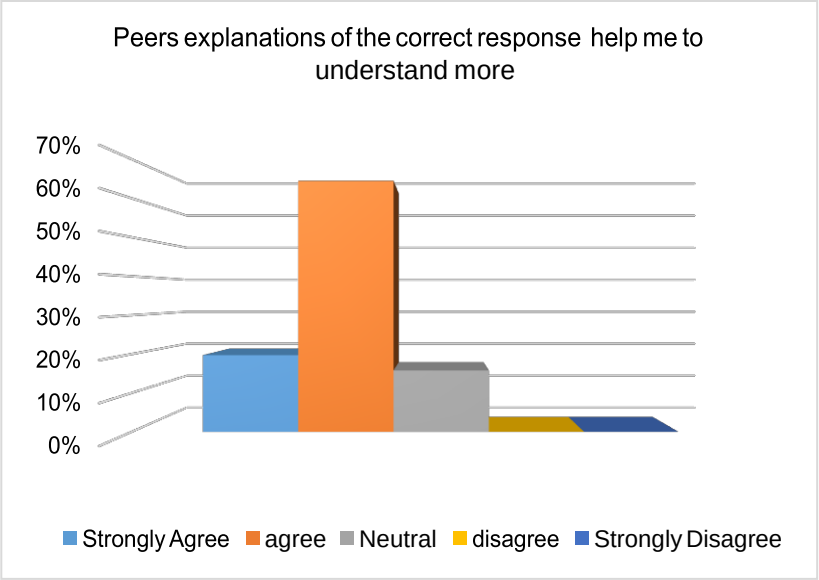

Figure 18 Peer explanations of the correct response help me to understand more

Table 7. Peer explanations of the correct response help me to understand more

Item	Number of Students	Percentage
SA	15	19.73%
A	49	64.47%
N	12	15.78%
D	0	0%
SD	0	0%
Total	76	100%

The above chart and table show how peer explanation is important for students to understand a given topic. Around 75% of the students think that this strategy is helpful to improving their understanding. It can help them to clarify

misunderstandings or rectify mistaken answers. 12 students responding neutrally to this statement. The reason for this, as was raised during the group interviews, was that some students are not cooperative during discussions. Therefore, the relationships between students and the nature of their interactions are important to achieving a deeper understanding, but students need to be motivated to cooperative. There was no disagreement with this statement, which shows the importance of interactions between the students during the learning activity.

7. The anonymity of PRS

The following chart and table show that the majority of the students prefer anonymity based on the data from the questionnaire.

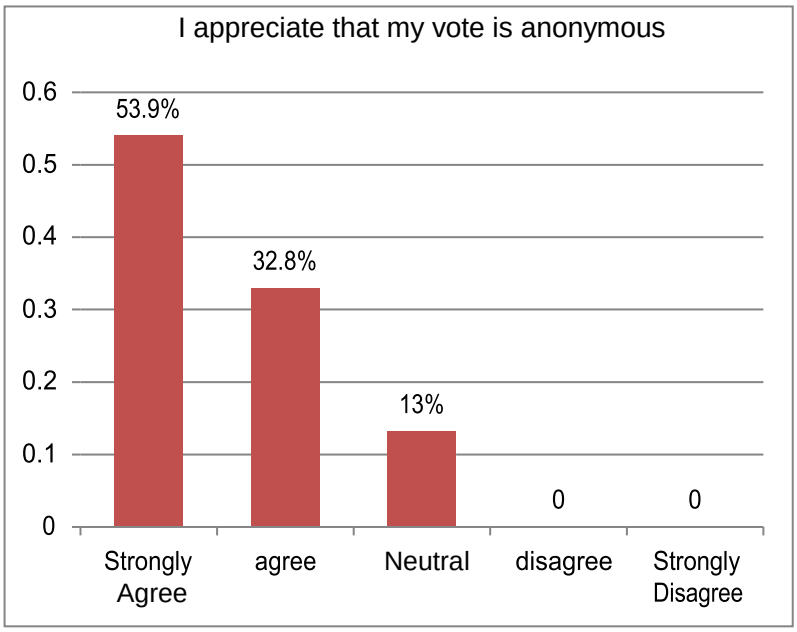

Figure 19 I appreciate that my vote is anonymous

Table 8. I appreciate that my vote is anonymous

Item	Number of Students	Percentage
SA	41	53.94%
A	25	32.89%
N	10	13.15%
D	0	0%
SD	0	0%
Total	76	100%

The chart and table clearly show how much value the students placed on being able to answer questions anonymously; 66 students – 87% of respondents agreed. This could be explained by the findings from the qualitative data, where the majority of respondents said that they could be shy or fear participating in the traditional lecture format. There is no disagreement for this statement. Surprisingly, 10 students responded neutrally, which may confirm what some students reported about anonymity in the group interview. Some students preferred to be identified during the learning activity and considered the recognition a reward for them if they chose the right answers.

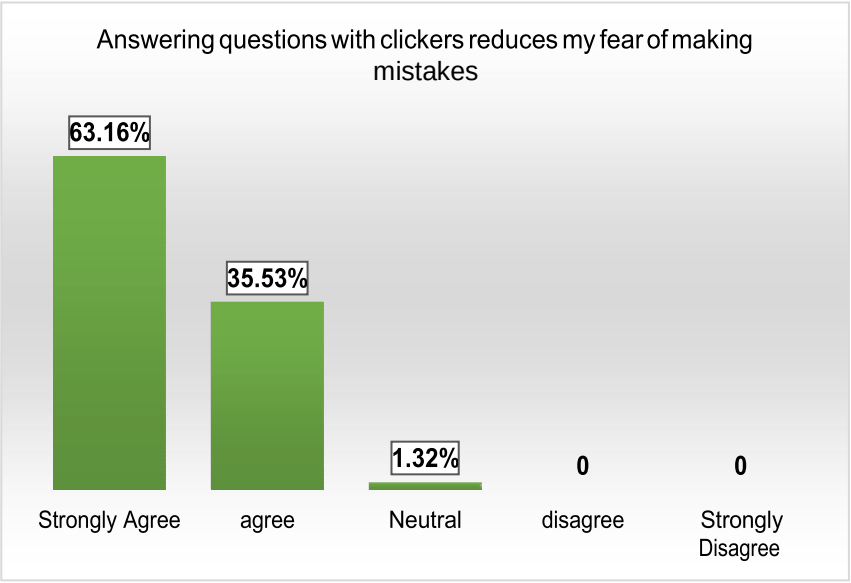

Figure 20 Answering questions with clickers reduce my fear of making mistakes

Table 9. Clickers reduce my fear of making mistakes

Item	Number of Students	Percentage
SA	48	63.15%
A	27	35.5%
N	1	1.31%
D	0	0%
SD	0	0%
Total	76	100%

The affordance of PRS has reduced the fear of participating in the lecture for many students due to the anonymity of answering questions using a clicker. This is illustrated in the above chart and table; around 63% of students surveyed strongly agree that the system has reduced their fear of participation. Moreover, around 36% of the participants agreed with this statement, which shows a positive perception toward using this technology to increase interaction in the classroom and reduce nervousness associated with participation. There is no disagreement, as can be seen in the chart, and only one student answered 'neutral'. This confirms the extent to which the system helps students to participate and increase their confidence.

8. Immediate feedback

The students can receive immediate feedback measuring their understanding when they use PRS, particularly if they fail initially to understand. This is illustrated in the following chart:

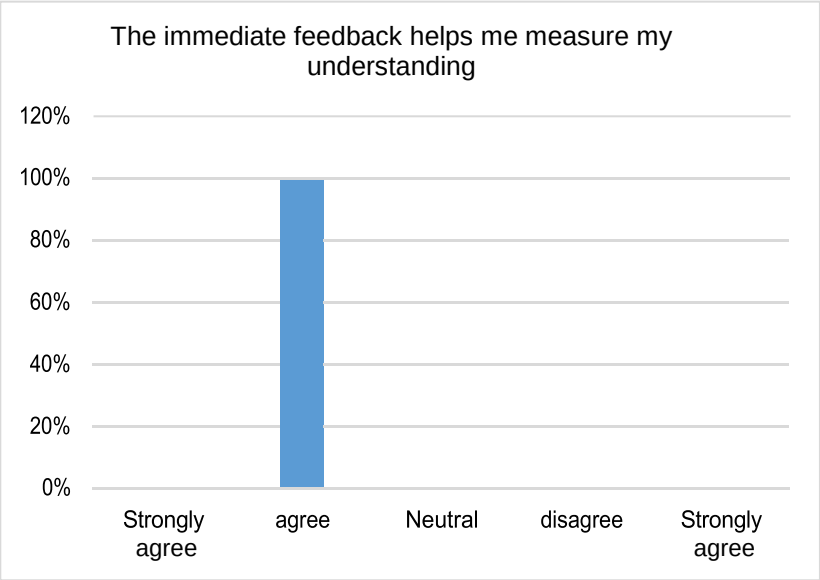

Figure 21 The immediate feedback helps me to measure my understanding

Table 10. The immediate feedback helps me measure my understanding

Item	Number of Students	Percentage
SA	0	0%
A	76	100%
N	0	0%
D	0	0%
SD	0	0%
Total	76	100%

The above table presents the importance of immediate feedback from the PRS to increase students' understanding and to promote interaction in the classroom. All the students agreed that the feedback from the system helped them to measure their understanding. If they did not understand something they would be able to identify their weak points and ask for further clarification, which is a new role for the students in the PRS activity compared to the traditional class format. Moreover, this is an indication of the new role for the lecturer, who can measure

students' understanding and offer feedback. There is no disagreement with this statement.

9. PRS as motivation for students

The students reported that the atmosphere of a PRS based lecture was an attraction for them because it changed relationships between them.

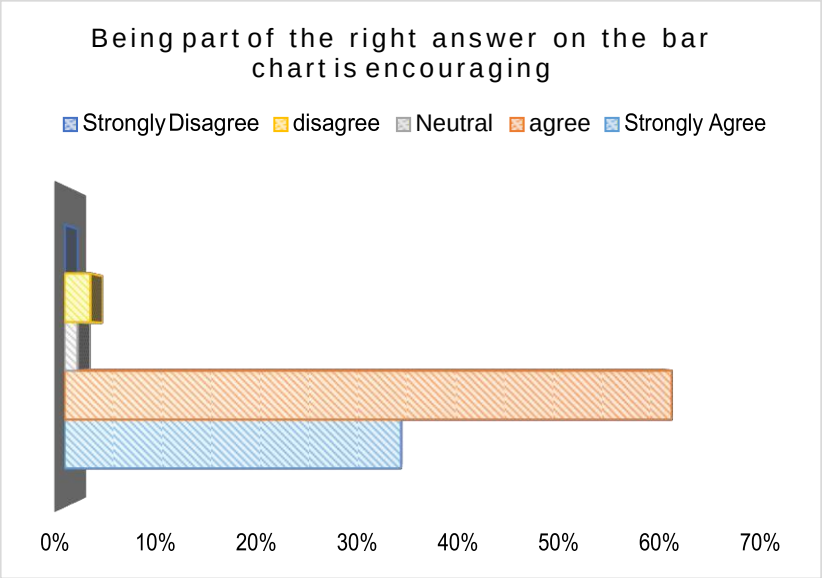

Figure 22 being part of the right answer on the bar chart is encouraging

Table 11. Being part of the right answer on the bar chart is encouraging

Item	Number of Students	Percentage
SA	26	34.2%
A	47	61.8%
N	1	1.3%
D	2	2.6%
SD	0	0%
Total	76	100%

The above chart and table show how important it is for the students to see their answer in a histogram and the impact on their confidence to be in the group who chose the right answer. Moreover, showing the answers facilities the competitive

relationship between the students. A high percentage of participants (around 34%) strongly agree and 61% of the participants agree with the statement. On the other hand, a small percentage (2%) of the participants disagree with this statement. This suggests that being in the group who chose the right answer leads to greater motivation. The disagreement shows that being in a group who choose the wrong answers may have a negative impact on the students, potentially reducing their confidence and lowering their motivation to participate in group activities. The qualitative data indicates that PRS can be a motivation to learn and interact within the classroom, which can also be observed in the quantitative data, as shown in the following chart.

The following chart illustrates the strategy for using PRS as well as how it can motivate students to learn the course materials.

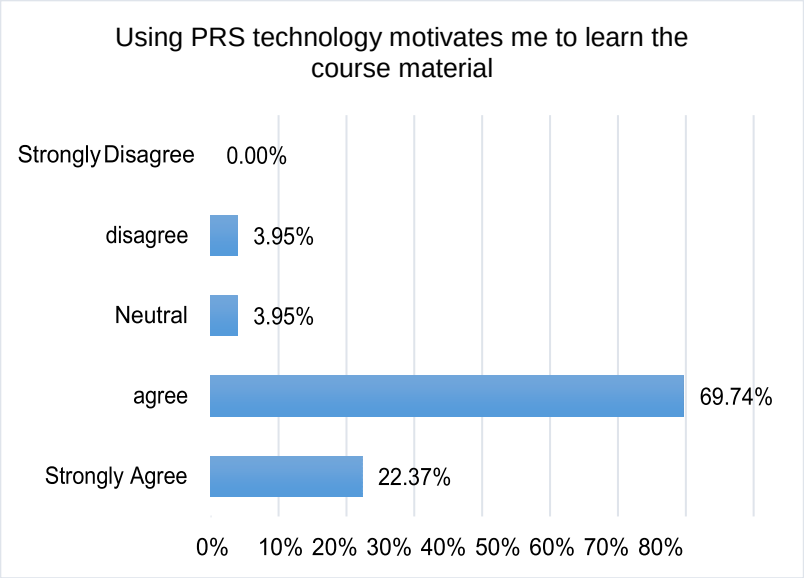

Figure 23 Using PRS technology motivates me to learn the course material

Table 12. Using PRS technology motivates me to learn the course material

Item	Number of Students	Percentage
SA	17	22.36%
A	53	69.73%
N	3	3.94%
D	3	3.94%
SD	0	0%
Total	76	100%

Fundamentally, the data collected from the questionnaire confirms the strategy for using PRS as motivation for students to learn new material. The above chart (Figure 22) clearly illustrates that 92% of students are encouraged to learn more when using PRS technology. Only 4% of students (3 students) did not feel they were encouraged to learn during PRS based lectures. That might be because the system is quite new for them and they may struggle to use it. However, the majority of participants were motivated to learn the new materials with PRS, which shows a positive perception toward using this technology.

10. Learning experience

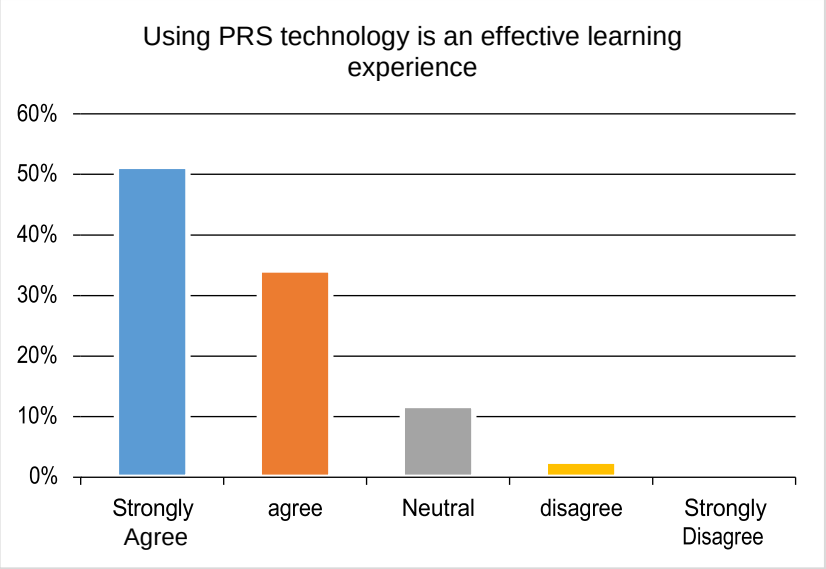

Figure 24 Using PRS technology is an effective learning experience

Table 13. Using PRS technology is an effective learning experience

Item	Number of Students	Percentage
SA	39	51.31%
A	26	34.21%
N	9	11.84%
D	2	2.63%
SD	0	0%
Total	76	100%

The above chart and table show that more than 50% of students strongly agree and around 35% of students agree that using PRS is an effective learning experience. As illustrated in the chart, most of the students enjoyed using this technology. Moreover, they feel they learn more through constructing knowledge by interacting with their lecturer and the other students. Further, they may have more fun through using this technology which improved their experience. It can be concluded that the implementation of PRS will have a positive impact on the learning outcomes for many students. However, around 3% of the participants did not agree with this statement. The majority of the students experienced a recognisable improvement in their learning, leading them to believe they are more likely to achieve their objectives (deep understanding) using PRS. From this chart we can see the relationships between the students themselves and the lecturer have improved, which has had a noticeable influence on their learning outcomes. Without these relationships, students would not have such a positive learning experience, as in the traditional lecture where students relied more on memorizing the information after the lecture without real interaction. Essentially, using PRS (and the way of using the system) helped to improve the learning outcomes for most students.

11. Conclusion

In this chapter the findings from the questionnaire have been described and explored, indicating changes in roles for the students. These findings suggest a positive impact upon the relationship between students and increased interaction based on the accuracy of their answers. Moreover, this improved relationship appears to be a motivation for students, encouraging them to participate more in discussion. The findings indicate how important the discussion may be for the students' learning. The discussion between students seems to help them to correctly answer the questions and construct their understanding accordingly. Additionally, the students believe their knowledge retention increased as a result of the interaction between them during the learning process. This interaction has changed the students' role; with PRS they may help each other by explaining and correcting any misunderstandings.

One of the most important finding during this phase of the study is that the majority of students were able to participate during the PRS activity. One reason for this may be the affordance of anonymity with PRS questions, which may have reduced students' fear of failure, and thus increased their willingness to be involved in the learning activity using PRS. Moreover, the immediate feedback provided by the system encourages students to engage more in their learning and receive help to correct any misunderstandings from other students or their lecturer. Being a part of the group who chose the correct answers might provide motivation for the students to learn the course materials. All these aspects have produced positive learning experiences for the students. However, due to the lack of time allowed for this study the questionnaire was not tested prior to distribution. The data collected from the questionnaire have been used to partially construct an understanding of the use of PRS, supplementing the qualitative data.

Additionally, the constructionist approach to data gathering was adopted during this questionnaire, meaning that students' responses were partially constructed by the survey and its questions. This means the answers for the questions were gathered and analysed, and an initial picture of the use of PRS was created based on these. These findings will be tested and elaborated upon through the qualitative analysis in the next chapter.

Chapter 6: Qualitative Findings

1. Introduction

The importance of AT in such research is proven in previous studies to provide a holistic approach to understanding a complex context, where individuals are interacting with each other and with their learning environment (Hasan, 1999). These elements are students, lecturers, the PRS, the rules for using this technology, the roles for the users and the objectives of the activity. Keeping AT in mind, GT has been chosen to provide a comprehensive analysis of the research findings. Moreover, GT informed this study by identifying possible relationships between the different factors in the educational environment. Crooks (2001) reported GT is an ideal way for exploring integral social relationships, the behaviour of groups in a particular context and factors that affect them. Therefore, the data was collected and analysed using GT to find the relationship between the different extracted themes.

Following an initial descriptive statistical analysis of survey data, the remaining data in this study is analysed qualitatively in order to answer the research questions. However, around 13% of the data was discarded as it was not related to the research questions and was a form of preparation for the interviews, or the result of participants telling stories irrelevant to the research topic or short answers in the questionnaire. The majority of the data (around 87%) was used to answer the research questions as it was deep and detailed. The research questions were formulated to understand the use of the PRS technology in the educational environment and its influences on the learning activity. The main research questions are:

1) How does PRS influence relationships in the context of the education environment?

2) How does PRS influence the students' experience in the education environment?

3) What are the implications of using PRS?

Keeping these questions in mind the following chapter will answer each of the research questions. The two main sections report relevant analysis of the relationships in the PRS activity and influences of PRS on students' experience while the third research question will be covered in the discussion chapter, which follows this one.

As explained in Chapter 4, this study relied on group interviews with students; semi-structured interviews with lecturers and questionnaires. In this chapter the results of the qualitative methods will be discussed.

2. The relationships in the PRS activity

The data were collected through group interviews for the students and semi-structured interviews for the lecturers, and these will be used to answer the first research question. The components of the activity in the educational environment were selected based on the data. The many components forming this activity have been introduced in previous chapters. These include the lecturer, students, rules of the PRS activity, the roles of the users, the objectives of the lesson and PRS as a main tool for the activity. Based on the data and its interpretation, there are two activity systems. These activity systems have the same mediating tool and rules, but different objectives, rules and roles for the subjects (the lecturer and students). Both lecturers and students participate in the activity to achieve their desired objectives. The lecturer in each case sought to deliver the concepts and get students to understand the content, whereas the students sought to

receive the information and construct their understanding of the meaning and content and relate it to the subject.

This process can proceed through interaction between a lecturer and their students and among students using PRS technology and applying the rules of the activity, as will be shown in this chapter. As previously discussed, the main focus of the data are the relationships between the components of the PRS activity. Investigating the relationships between the elements of the PRS activity will lead to a conceptualization of it. This activity and the relationships involved will be identified through data analysis which is informed by the GT approach to highlight the themes and AT to find the relationships between these themes. In order to identify these relationships between the components, each relationship was categorised by codes, which will be specified and discussed in the following section. Each relationship will be analysed separately from other relationships to illustrate the relationships between all the elements. That will lead to the conceptualization of the whole system and a greater depth of understanding.

2.1. Enhanced relationship between the lecturer and the students

The students and lecturer are essential components and important actors when processing the activity systems. The data from the questionnaire shows 75 out of 76 students suggest their relationship has generally improved through using PRS technology, through offering feedback and more explanation (see Table 11, Chapter 5).

2.1.1. Increased communication

In the group interviews, many of the students (18 students) think they can communicate more with the lecturer and their relationship with the lecturer has changed when they use PRS. For example, student 23 reported:

> *"The PRS offers flexibility to the way we communicate with a lecturer, I can receive questions from him and I can ask him any questions if I did not understand a specific matter during the lecture. I feel receiving more questions from the lecturer during the lecture encourage me to ask him freely. Whereas, in the traditional lecture that was quite difficult because I used to feel shy and similarly other students did not usually ask."*

This shows how PRS has changed the concept of the traditional lecture. The students normally avoid asking questions in the traditional lecture, because it was not part of their habits, with the exception of a few students who were actively participating and asking questions. Moreover, we can infer from that how the PRS rules mediate the relationship between the lecturer and students, which leads to achieving the objectives in each activity system.

2.1.2. The rules of PRS activity improve relationships

The rules of the PRS activity have an essential role in mediating the relationship between the students and lecturer and their objectives, as is indicated throughout this chapter. By analysing interviews with lecturers, other aspects of relationships were further highlighted. For example, lecturer 2 mentioned that:

> *"In the traditional lecture, the relationship between me and my students is generally formal, because it is impossible to ask a question to all of them and if I use short quiz that will need a lot of time to be done. The lectures are generally short and cannot be spent asking too many questions. Hence most of them feel difficulty to answer or ask questions".*

7 further lecturers agreed, stating that they think the relationships with students were ineffective in the traditional lecture. That affected the ability for both students and lecturers to achieve their objectives. Therefore, introducing PRS technology has offered the possibility to change the nature of the relationship between the lecturer and the students for the better. Some participants (16 students from the group interview) reported that the ability for lecturers to assess students' understanding (as a lecturer role) has positively affected their relationships with the lecturers. For example, student 13 reported:

> "*Through using PRS I felt the lecturer became closer to me through the ability to measure my understanding about specific issues (such as understanding concepts and relate them or some biological processes) and give more explanation if I do not or have difficulties understand it*".

Basically, a 'closer relationship' here refers to the ability to know if the students understand an aspect of their learning through their answers using the PRS questions. This is a new role in the activity.

2.1.3. The roles for lecturers in the PRS activity improve relationships

8 lecturers agreed in their interviews they are more able to gauge students' understanding before it is too late in the final exams. For example, lecturer 1 stated that:

> "*Using the PRS has offered me an ability to measure the student's understanding of the different concepts during the lecture, however that was quite difficult in the traditional lectures*".

Surprisingly, some students (8 students) felt the lecturer did not care about their understanding in the traditional lecture, but this has changed when using PRS. For example, student 8 stated:

> "*I felt that it was not important for the lecturer if we understand the content or not, because he was not able to measure our understanding of the content or we felt he gave the information and left us without feedback. Showing the result of our answers of the PRS questions give him ability to do so and give more explanation before moving to new topics or material*".

Therefore, the lecturer can expand their explanation if many students choose the wrong answers or move to new point if they choose the right one. This has a great impact on the relationship between students and lecturer; it certainly provides better insight for the lecturer.

However, some students (6 students in the interview) noticed the lecturer did not give attention to a small percentage of the wrong answers at times a role for him in the activity. For example, student 2 explained that:

> "*The drawback of showing the result of the answers is the lecturer does not give attention to small percentages of the wrong answers; lecturers should not neglect wrong answers even if they were very few*".

Not giving feedback means the lecturer did not play the ideal role in the PRS activity. 6 students reported that the lecturer's behaviour reminded them of traditional lectures, where sometimes the lecturer gave more attention to distinguished students. Therefore, answering the PRS questions (as a role for the students to construct their understanding) was not enough to change the relationship between the lecturer and the students unless the lecturer applied the rule by offering feedback. It was reported in the quantitative findings that all students' responses supported that (Table 10, Chapter 5).

The affordance of PRS and rules improve relationships between the lecturer and the students. Nevertheless, an inappropriate use of PRS does not help improve the relationships between lecturers and students. Fundamentally, the ability to assess students' understanding, for example, refers to the affordance theory postulated by Gibson (1977). Initially, PRS appeared merely to be a tool for asking questions and showing the answers. With frequent use and improved planning for lectures, the lecturers perceptions changed and they began to see it as a tool to assess the students' understanding which could be used to give more explanation if their answers are wrong, improve their relationships with students and get them to understand the content. For example, lecturer 1 highlighted that:

> "*Using the PRS has offered me an ability to measure the student understanding of the learning concepts before moving on to new material, while it was quite difficult in the traditional lecture. Traditionally it was difficult to generate such understanding of students' understandings*".

Therefore, this feature was available for the lecturers, but they did not perceive this affordance as result of lack of experience in using this technology. Moreover, the lecturer and PRS can constrain this affordance. For example, technical

problems sometimes did not allow lecturers to present students with their answers and that limited the affordance of PRS. Additionally, lecturers can constrain and limit the affordance of this feature. For example, some lecturers do not pay attention when a small percentage of wrong answers are given. That shows the lecturers sometimes did not perceive the importance of this feature. Therefore, the affordance in PRS activity appears as a relationship between what PRS may offer and what can be perceived by the lecturers. Affordance theory will be applied to different features of PRS in the analysis chapter; there are many examples throughout.

2.1.4. No change in the relationship

It is safe to say that although the majority saw changes in the relationships in the classroom, two students remained 'neutral' as they did not notice any change to their relationship with the lecturer. Their justification is they are still unable to communicate with the lecturer directly by asking questions, but only indirectly through the PRS system. As an example of their opinions, student 3 reported:

> *"I still have difficulty in communicating with the lecturer because I feel shy or sceptical of asking a question to him directly. However, I can answer the question and I know he will give more explanation if I don't choose the right answer, because we are going to receive feedbacks from him."*

They felt nervous when they attempted to communicate with the lecturer, because they are afraid of making mistakes or of the lecturer's reaction of their questions. The nature of the relationships between the students and the lecturers in Saudi Arabia in higher education are often more formal. This formality comes from the rules of the traditional lecture, where the lecturer talks and the students listen. Furthermore, the students need to ask permission to talk or ask questions. Therefore, the students try to be more careful when they attempt to ask a question or participate.

On the other hand, two lecturers felt that improvement did not happen with all students and that PRS is effective for some students and not others. For example, lecture 4 reported that:

> *"There are students who are not influenced by using the PRS technology, because they do not ask question as they were affected by choosing the wrong answer. They ignore giving answers and seem more resistant to the PRS technology".*

A few students kept silent during the lectures (not applying the rules or playing their roles) and the lecturers could not be certain how they felt about the lectures. This has constrained the lecturers' activity as well, because the lecturer may not be able to fulfil his role. This is another indication that some students using PRS are still influenced by their previous experience of traditional lectures.

2.1.5. Constraints on the relationships

Although the relationship between students and lecturers has improved, some students reported the length of time for the lecture and the content did not encourage more communication. For example, student 2 mentioned that:

> *"The time for the lecture and the amount of information limited our ability to receive or ask questions to the lecturer, because the lecturer is not able to use the system more than one or two times during the lecture".*

According to AT the rules of the activity mediate the relationship between the subject and community. Therefore, the time and content are constraints effecting the application of the rules, and thereby the relationship between the students and the lecturer, so the activity cannot work effectively. This does not allow students to ask or receive any questions about the concepts in the lecture in order to build an understanding (13 students reported this).

7 lecturers agreed with their students that time and the amount of content to be delivered in one lecture sometimes does not help increase or improve the communication between them. For example, lecturer 8 stated that:

> "*Even though I plan accurately for the lecture, because of the amount of the content for the lecture sometimes I do not have time to ask more than one or two questions and that will affect the relationship between me and the students. It is hard to balance this technology when you have too much material to teach during the lecture*".

In some lectures the time for delivering content does not help participants to use PRS sufficiently or does not allow time for discussion or asking questions. Not incorporating PRS certainly perpetuates a traditional environment and as a result this has affected the relationships between the students and the lecturers and may lead to problems in achieving the learning objectives. Despite these constraints and limitations, clearly there are positive effects of the PRS; benefits that have a more powerful influence on the relationships between lecturers and students, helping them to reach the learning goals. The PRS and its rules have changed the relationship between students and lecturers and enable each of them to interact more with their new roles to reach their objectives.

2.2. The relationships between students

As well as changing the relationships between students and lectures, it must be established how this technology changes relationships between the students themselves. Modern educators believe that learning is an interactive and social activity, where learners interact together to construct their understanding (Laufgraben & Shapiro, 2004). Since AT is a social learning theory which takes the Saudi higher education context into consideration, where we can see the influences of PRS on the relationships between the students and their learning behaviour through the interaction between them. According to the theory of social

learning the majority of learning occurs in a social context, where individuals observe other strategies for learning, skills and beliefs and interacting with other students (Bandura, 1976). Lave and Wenger (1991) explain learning as not merely achieving pedagogical goals or official agendas but increasing participation in an educational environment and imply learners act through social relationships in the environment. Here students' positions changed from passive learners to learners who participate and contribute to the learning activity. Therefore, learning can be achieved through transformations of activity systems (Arnseth, 2008).

2.2.1. Cooperation between students (during class discussion)

The first pattern identified by the majority of the participants (16 students in the group interview) is that learning and cooperating with each other took place more with individual use of PRS. 6 of the lecturers and 16 students perceive learning occurring through answering PRS questions individually, discussing their answers with other students and the lecturer and receiving feedback. For example, student 11 reported:

> "*I could learn from other students during the activity more than the lecturer, through asking other students about the answer for a question and how did they choose the right answer and he can justify that*".

That learning can happen through answering questions using PRS or during discussion, particularly if misunderstandings are corrected. After each question the lecturer offers a few minutes for discussion. In the group interview, 16 students reported they can discuss their answers and share knowledge in PRS based lessons more than in traditional lectures and they felt the rules of the PRS activity encouraged them. For example, student 7 stated:

> "*In the traditional lecturer there was not encouragement to interact or ask other students, because we are not allowed to talk during the lecturer or disturb. With the PRS technology, it is a part of the activity to ask other students and they need to justify their answers*".

Moreover, the students in the traditional lectures could not interact with other students to answer the questions correctly as form of transmissive learning. In this form of learning the students do not have an opportunity to reflect on their learning as they learn from the lecturer's explanation only. Thus, sometimes they prefer to not ask questions of other students to avoid embarrassment if they do not know the answers or receive the wrong answers. For example, student 4 highlighted:

> "*In the traditional lecture we do not know who knows the right answer for some questions, so I prefer to not ask anyone. With the PRS technology there is a possibility to get the right answer, because everyone knows what his answer and if it is correct or not. So, it was better to listen to the lecturer's explanation in the traditional lecture*".

Therefore, using the PRS activity might encourage students to ask each other questions; those who had the wrong answers can seek help from other students with less fear of embarrassment. As a result of this improved relationship between students, learning has changed positively. This could give them an opportunity to think and justify their choice and construct their understanding. The rules of PRS have helped students to get involved in the learning process and successfully construct their learning in different ways on many occasions.

2.2.2. Competition between students

The second pattern of the relationship between the students is competition. Most of the students (12 students from the interviews and 64 from the questionnaire; see Table 7 and 8) believe this relationship has changed positively with the use of PRS as it provides a kind of competition to answer questions. The students felt

encouraged to participate and choose the right answer in order to be part of the group who choose the right answers. For example, student 10 reported:

> "*There is a kind of competition when we use the PRS because every student want to choose the right answer and be in the group of students who choose the right answer, I felt encouraged to do so and participate in this healthy competition*".

Thus, the relationship between students has become more competitive. This type of relationship encourages students to have fun and learn in a competitive manner.

However, this is not always the case because some participants (7 students) see this change in relationship as negative. They perceived this new behaviour as increasing jealousy and decreasing cooperation. For example, student 6 reported:

> "*I feel using the PRS technology leads some students to have an aggressive competition. I mean some students were trying to hide the correct answers because they do not want other students as good as them. Some want to maintain their superiority and knowledge and keep it to themselves and that is unhealthy in a learning environment*".

The lecturer has an important role to impress the importance of cooperation upon the students along with the aim of using the PRS system. For example, lecturer 2 stated:

> "*I noticed the students feel jealous of each other and they try not to cooperate in order to be distinguished from other students who do not choose the right answer. Therefore, I had to notify those students of their behaviour and that they have to cooperate and promote positivity in the classroom*".

From this statement we can infer that PRS technology may cause negative effects on the relationships between students, and thereby will effect the whole activity; however, this only seems to be the case among a minority of students.

2.2.3. Using PRS in groups

The third relationship pattern is cooperative participation or using the system as a group. In some lectures, the PRS technology was used by small groups of students. According to the lecturer who used PRS in this way, the reason for using this approach is because the number of students in the lecture is reasonable (around 26 students). Moreover, the amount of content in some lectures is less than in others, which allows students to use the PRS system in groups. Only two lecturers used this approach for a few of their lectures.

The students cooperated with each other to increase their understanding of the content. For example, student 9 stated:

> "*Using the PRS with the group is more beneficial than using it individually, as I can understand the meaning of the question because some terms were difficult and I can understand them in a group*".

When they work as a group, they have enough time to discuss each question, ask about new terms and listen to other students' answers and their justification for those answers (6 students reported this in the group interview). The students felt their relationship had improved through using PRS in groups. For example, students 7 reported:

> "*Working as the group is making us cooperate to choose the right answer and everyone make his best to justify his answer, and many times I gain the whole idea through listening to their answers"*.

Some students felt other students could be a source for understanding. They reported that this feeling came from the ability to understand many concepts from their peers, more than from their lecturer. Some agreed that students might use simpler language and be able to explain some of the harder concepts more clearly.

Furthermore, some students (18 students) felt their inter-student relationship became more flexible with the use of PRS in groups, since they could ask one another questions and for reassurance without the feeling of shyness or embarrassment they experienced in traditional lectures if they showed they had misunderstood something. For example, student 10 reported:

> "*With the PRS I felt more able to ask questions to other students and I do not feel embarrassed when I say I do not know the answer, as many students have the same difficulty. We joke about not getting the question right and have fun and get on with other questions*".

Therefore, using PRS has improved the relationships between students and broken barriers between them. This improvement helped students to reach their learning objectives, which was to understand the whole content. Many students (64 students who responded to the questionnaire; see Table 7) think they can understand more when using PRS and applying the rules for the activity, which helps them to construct their learning.

Nevertheless, these relationship patterns are not consistently positive. A number of students (11 students in the group interviews) reported that sometimes they did not feel any improvement in their relationships with other students. The reason given for this opinion was that not all students were cooperative, nor they did not pay attention to the PRS activity. For example, student 4 stated:

> "*Some students did not cooperate, and that caused distraction for me, as that was affecting sharing knowledge and learning from each other, they depend on others to teach them all the time without giving anything back*".

This is one of constraints for the PRS activity as some students did not engage in the activity. The lecturers and students believe the PRS activities have given more opportunities to realise their learning or teaching objectives and to improve

relationships between students by mediating these relationships through application of the rules.

2.3. The relationships between students and their learning objectives

Based on the data collected, the ability for students to reach their learning objectives has remarkably improved through using PRS and applying the rules for the activities. Most of the students (16 students who participated in the interviews) reported that their objectives have changed to more core objectives and are more achievable. For example, student 21 reported:

> "*My goals have changed from only attending the class to understanding deeply and compete with other students. We attended the traditional lectures because there is assigned marks for attendance that's all as we all felt that we could learn the material without attending*".

Therefore, using PRS has changed their learning objectives and the way they attempt to achieve them. One objective stated by the majority of students was an understanding or a deep understanding of the topics. The data suggests achieving this objective was mediated by PRS technology, the rules of the activity and the students' relationships with their lecturer and other students.

The PRS questions (as one of the rules) are important in increasing students' understanding of the course content. The relationships between the students and their objectives has been effected positively by using PRS to improve learning, as they reported. One of the points some of them mentioned in their interviews (11 students) about their objectives is that they are more able to discover the important points of the lecture content when using PRS. For example, student 3 said:

> "*Often the lecturer asked about the most important points in the lecture, therefore it was easy for me to know these points and focus in them. We get the understanding that if the lecturer asks about something that question is what we should focus on when we learn*".

This helps students to concentrate on these points and go forward in their understanding of the whole content of the lecture.

Essentially, the rules of the PRS activity helped students to maintain a high level of concentration during their lectures. Many students (14 students from the group interviews) reported that it became easier for them to concentrate in their lectures when using PRS. The students needed to follow the lecturer's explanation during the lecture to ensure they didn't miss any information and be able to choose the right answer when the PRS questions were posed. That helped them to understand each point and make connections between these points and the topic. For example, student 8 stated:

> "*Using the PRS helped me to concentrate during the lecture and understand each point of the lecturer is making, this is helping us concentrate compared to normal lectures that do not involve PRS*".

Therefore, PRS increases students' concentration, unlike the traditional lecture. This is an indication of how PRS and the rules mediate between students and their objectives (understanding the content). Nevertheless, PRS itself or the rules of the activity may be obstacles to achieving deeper understanding. Technical issues that can occur during the lecture cause distractions for the students. Moreover, the rules of the PRS activity can be a dilemma for the students, preventing them from reaching a deeper understanding. For example, the clarity of the questions, the time put aside for asking the questions, time allowed for discussion after each question are factors effecting the relationship between students and their objectives.

Several students (18 students in the group interviews) suggested that they memorized the information after the traditional lecture to understand the content, which may refer to their method of learning without PRS. However, with PRS,

they can understand the content more deeply as there is a greater chance of memorizing the information while using the PRS and discussing the answer with their fellow students. Moreover, a few students (4 students) reported that within the PRS activity, they are more able to compare concepts, apply some concepts, analyse some information and evaluate the value of the information. According to Churches (2009) these represent high levels of Bloom's Taxonomy for learning. For example, student 3 reported:

> "*With the PRS there is more possibility to memorize the new information during the lecture, more than that I can compare between the categories (for example) of the blood and the common blood diseases, when I explain my answer to the other students*".

That shows how the students' learning developed after using PRS technology and the ways in which using this technology was useful for them. Comparing newly assimilated information is a higher level of learning than trying to memorize the information, like in the traditional lectures. Their ability to memorize information in the lecture with PRS is higher as result of their interaction with other students.

Generally, the relationship between the student and their objectives shows achieving the objectives become more possible through interacting with other students and sharing knowledge with them (18 students reported that). For example, student 16 stated:

> "*I can learn more concepts through asking other students and listen to their answers and justification, this allows different perspectives and explanations in addition to those made by the lecturer*".

Even if students did not understand a concept from the lecturers' explanation, they had another opportunity through the use of PRS. Discussion after each

question (as a rule for the activity) will allow students to ask questions of their peers and receive explanations, which is a form of social constructivist learning.

Only three students reported that it was impossible to achieve their objectives with PRS because of the associated distractions. For example, student 12 reported:

> "*The technical issues that happened sometimes do not help to achieve my goals, because the lecturer stops lecturing to solve the problem and hence wasting time. Such technology is useless if technical problems persist during the lectures as we and the lecturer get frustrated*".

Moreover, students reported the difficulty of PRS questions and the time for asking these questions do not allow objectives to be achieved. For example, student 9 stated:

> "*The difficulty of the PRS questions made understanding the meaning of the concepts even more difficult or sometimes asking the questions before I understand the point in the lesson. Time could be an issue here as I prefer to understand a point before we are asked about it*".

Many students (7 students) reported the dilemma of achieving objectives in the PRS activity sometimes it means dealing with unmotivated students. A similar number of students reported the same issue in the questionnaire (see Table 4). Cooperation between students is an important factor in building their understanding of the meaning of many concepts and finding the connection between points covered in the lecture. For example, student 10 said:

> "*I understand the content more when I cooperate with other students and discuss the answer; however, not all the students are cooperative. So I feel it is difficult to understand a specific issue or question with those students*".

In fact, achieving the learning objectives (understanding the content deeply) in the PRS activity is not always possible. There are many tensions between the

elements of the activity effecting the relationship between the students and their objectives.

Analysis of this relationship indicates its importance and that it has been positively effected by integrating PRS into the learning process. This relationship is mediated by PRS, PRS's rules, other students and the lecturer. However, the data shows there are sometimes constraints and limitations in the relationship between the students and their objectives caused by these components. These constraints are not common or universal, and where they do occur are often outweighed by the positive benefits of PRS identified in previous sections.

2.4. The relationship between students and the rules

Fundamentally, the relationship between students and the rules can make a significant difference to the PRS activity. Students and lecturers mentioned how important the rules are to the activity. Many students (17 students in the group interviews) reported that the rules of PRS technology empower participants to achieve their objectives.

2.4.1. Time limit for answering the questions

Many students (12 students in the group interviews) believe that being given insufficient time to answer questions will encourage them to make random choices or not participate. For example, student 2 stated:

> *"Not giving sufficient time to answer could be a major problem. That will affect my ability to participate and choose the right answer. This happens sometimes when questions are rushed, and answers are rushed too. That way the PRS cannot be as effective*".

In this case, the students start to choose the answers randomly without thinking about the right answer, and this may effect their understanding of the content. As result of that, students are not able to measure their understanding, and thereby

their ability to make connections between the concepts and discuss their answers is compromised. For example, student 4 stated:

> "*When I feel that there is not enough time to think and choose the right answer, I would rather not to participate, as that might give a false indication to the lecturer and fellow students*".

Using PRS with insufficient time will make this technology useless; this defeats the purpose of PRS, which promotes better learning and a better learning environment.

On the other hand, some lecturers (5 lecturers) believe allowing more time will cause a loss of control within the class and of the lecture schedule as the students will start to talk, become distracted and get bored. For example, lecturer 6 stated:

> "*Giving more time for answering the questions will lead to losing control or the student will get bored when they finish choosing the answer. Moreover, they may start to talk or play with their phones*".

Therefore, the data suggests imposing a time limit for answering the question is an important rule because it may affect the use of PRS technology and subsequently the whole activity.

2.4.2. The quality of the questions

Additionally, a few students (6 students in the group interviews) indicated that the quality of the questions is important for them to measure their understanding. For example, student 2 stated:

> "*The question is an important tool and making the activity more beneficial, therefore it should be made to measure my understanding of the essential points made or delivered through the lecture*".

The students believe the questions should be as challenging and clear as the questions they will face in the exams. PRS questions are key for the students to

be able to achieve their objectives. Providing poor quality or unclear questions may effect the whole activity.

2.4.3. Assessing understanding and teaching style

The questions are important for the lecturers as they enable them to measure the students' understanding through showing their results in a histogram. For example, lecturer 2 stated:

> "*The questions are important for me as lecturer, because it can measure the student's understanding and my way of teaching I will know what to focus more on and what to explain more*".

The anticipated outcome of using the PRS is developing learning and lecturing. One of the ways to develop lecturing is through assessing the effectiveness of lecturing based on the students' results. A high percentage of wrong answers because of unsuitable questions is disappointing to the lecturers. Fundamentally, the rule of showing the answers is helpful because students can measure their understanding and determine if they have misunderstood. The majority of the students (76%) in the questionnaire support this (see Table 2 in the previous chapter).

Lecturers can benefit from this by measuring their students' understanding and assessing their own pattern of teaching. In both cases we can see new roles for lecturers and students emerging. For example, lecturer 3 reported:

> "*Showing the answers for the students is a powerful way to measure the students' ability to identify the right answer and my teaching skills. Moreover, I can evaluate my teaching pattern based on the result of the students answers*".

Therefore, showing the students' results is a vital tool for both students and lecturers. The rules of the PRS activity are related and complementary to each other. Showing the percentage of right and wrong answers will not be effective without offering enough time to understand and answer the questions, or for

discussion and feedback. The rules of the activity have assigned roles for both lecturers and students to achieve their objectives and will be analysed later in this section.

There was neither opportunity nor motivation for students to ask questions in the traditional lecture format, as the lecturer led the activity with little input from students. For example, student 5 stated:

> "*In the traditional lecture there was not specific time or ability to ask questions about the lecturer. The lecturer kept talking during the lecture*".

Clearly, the relationships between students and their lecturers have improved through the application of PRS rules compared to the lecture style presently favoured by Saudi Arabia's universities, where students do not normally ask questions. Therefore, using PRS to pose questions and allowing time for discussion has made students more familiar with asking questions themselves. Thus, the rules of the PRS activity have changed the students' behaviour. Here, PRS has broken all the barriers and constraints for asking questions of other students or the lecturer, as perceived in the traditional lecture.

2.4.4. Discussion

One of the main advantages of PRS is discussion during the lecture. Discussion helps many students reflect on their learning and gain feedback from other students. Usually the discussion took place between 2 and 5 students in the lecture, for between 3 and 4 minutes (8 lecturers reported). Many students (17 students in the group interviews) find discussion after a question is very beneficial for their learning. For example, student 3 reported:

> "*Offering a time for discussion after each question with other students was helpful for me. Through that discussion, I can show my understanding of the concepts and correct any misunderstanding. Moreover, I can listen to other*

student explanations which are so useful for me and usually I can memorize their exploitation more than I do with the lecture".

The discussion option is a useful method to encourage students to interact and express their understanding to their peers, and to learn from other students' answers and explanations.

2.4.5. Strategy for using PRS

The relationship between the students and the rules/strategies of using PRS is fundamental to its success. With appropriate and clear rules for using PRS, students will perform better in an activity. One lecturer (lecturer 5) agreed that using the same strategy in each lecture leads to a loss of interest and becomes a tedious activity. Using PRS individually is useful for the students; however, using the PRS as a collective activity from time to time may make it more exciting for the students.

A preference emerged in the application of some rules; for example, the time made available for using the system. The majority of students (16 students in the interviews) preferred to use the system during the lecture. Students think this because they are more active throughout the lecture. For example, student 7 stated:

"*Using PRS during the lecture is more useful than using it only at the beginning or at the end. Asking frequent questions during the lecture will break the mode of the lecture and will change the atmosphere and encourage us to be active*".

Moreover, using PRS during the lecture will help students to understand every point at an appropriate time. Processing new information before understanding the previous point will lead to misunderstandings. Generally, concepts are presented in an appropriate sequence, where every concept will help students to understand the next concept. The transition from one concept to another must be structured; lecturers must ensure they give enough explanation for each concept

before moving to the next one. By using PRS during the lecture, the lecturer will be more able to either give more explanation or move to a new concept. For example, student 8 stated:

> "*Using the PRS at the end of the lecture will let us go through a great deal of information before we have the right understanding of these information. So, using the PRS during the lecture is more helpful*".

The data shows using PRS during the lecture might be more beneficial for them. The students receive questions during the lecture and participate and interact with other students, receiving instant feedback from the lecturer for each concept before moving on to a new one.

2.4.6. PRS without marks

The concept of using PRS without adding marks or value to the end of the module mark is essential. Students need to feel that they are not being marked on what they answer during the session. Some students reported (15 students) in their interviews that using the system without grades helped them participate without fear of making mistakes or being evaluated based on their answers. For example, student 3 stated:

> "*Using the PRS without marks motivates me because I will not be thinking about losing marks; if that was the case then I think I will hate the use of this system*".

Moreover, 3 lecturers agreed that using PRS without marks encouraged them to participate without stress or fear of losing marks. For example, lecturer 3 stated:

> "*Using PRS technology without marks will be more effective for the students to participate and interact, it is essential that they do not feel pressure and that wrong answers will effect their overall marks*".

On the other hand, one lecturer did not agree; he believes using the marks would make the activity more serious for the students, who would find it more beneficial. Lecturer 4 stated:

> "*Assigning grades for using the PRS will be efficient for the activity and students; I mean the student will take the use of PRS more seriously*".

Only two students preferred to add marks to the PRS activity. They were confident they would gain more marks and they could reduce the stress of the exams if this were put in place. For example, student 11 explained:

> "*Giving marks for choosing the right answer will be satisfactory for me because I feel I can get all the answers right and my participation here should be counted for in my overall mark*".

Generally, students and lecturers prefer to use PRS technology without marks as they see this method as more effective. There is an understanding among students and lecturers who think that marking PRS answers is not an idea that promotes positive participation and cooperation.

2.4.7. Type of PRS questions

Moreover, the possibility of using different type of questions is essential to get the full benefit of the system, as 6 lecturers reported. One lecturer thinks using different types of questions (multiple choice questions, true/false, short answer, matching, and so on) would be an effective tool for the PRS activity, however using multiple choice questions will save time and effort. A few students (13 students in the group interviews) suggested using different type of questions would be more useful for them. For example, student 3 stated:

> "*We currently use two types of questions multiple choice questions and putting terms in the right order. I believe adding an option to write my answer will be helpful. Variety of questions might enhance a different understanding of the topic studied*".

Indeed, offering different types of questions will keep PRS activities interesting for the students. The majority of the students (15 students) prefer to have multiple choice questions as most of the questions in the exams will be multiple choice questions. For example, student 7 stated that:

> "*I prefer to have multiple choice questions as we usually have this type of question in the exams and that will allow me to get used to the exam questions in mind*".

In Saudi universities, many lecturers prefer to use multiple choice questions for the exams as it is easier for marking and covers many aspects of the subject, regardless of the suitability of these types of exams. They believe it is important to maintain the same style of exam questions during the PRS activity.

In general, the relationship between the students and the rules of PRS has mediated the relationship between the components of the PRS activity for the students, regardless of what three of them felt about the rules of PRS. Most of the students reported that PRS rules have improved their relationships with other students, lecturers and PRS technology, and has led to achieving a deep understanding of their subject through participation in the learning process.

2.5. The relationship between students and the division of labour

It is common to see students act as passive learners in traditional lectures. The reason for this is the way the lectures were usually conducted as compared to newer, technology-based learning.

2.5.1. Active learner

According to the data, using PRS has changed the roles of students and lecturers within the classroom. With PRS technology, students reported that there are many essential changes to their roles and responsibilities. Most students (18) reported that their role has changed positively, encouraging them to become active learners instead of passive learners. For example, student 5 stated:

> "*Introducing the PRS technology has changed my role from just a receiver of the information to a student who can participate and explain to other students my opinion I can be more active and a cooperating student*".

Using PRS enables students to find another learning strategy; in this strategy they play an important role. Moreover, they need to understand every point to be able to participate and interact with other students. This has offered the students an active role in increasing their own understanding which can be a source for increasing understanding through cooperation with other students.

8 of the lecturers noticed that students using PRS act differently compared to those taking part in traditional lectures. Students can work on or contribute to the learning process to achieve their objectives, unlike in traditional lectures. For example, lecturer 3 reported:

> "*In the traditional lecture, students are only listening to the information. They did not have opportunities to participate, express their opinion and measure their understanding of a given topic. This is provided through the use of PRS*".

Nevertheless, lecturers reported that not all students have changed; some remain passive learners. i.e. PRS did not help everyone in the same way. For example, lecturer 3 explained:

> "*Some students have not changed with using the PRS compared to the traditional way. They prefer to keep silent without any action or not responding to the other students' action, this can be part of their personality or nature that is difficult to change*".

2 lecturers reported these students act the same way as in the traditional lectures. Those students preferred to listen to the lecturer's explanation rather than get involved in the learning process. For example, lecturer 3 said:

> "*Few students were acting the way they used to act in the traditional lecture because they used to be silent without any action in the traditional lecture and they do not want to change. I think they were afraid or shy of that change because they will spend more effort and have more responsibility*"

Therefore, PRS appears to have changed some students' roles in the lecture to being more active learners; however, that did not apply to all students. Clearly

some students find it more difficult to adopt new methods and prefer to stay as passive learners as they are comfortable in their traditional role.

2.5.2. Helping other students

The data suggests that discussing the answers after each question is helpful and can offer students a role as a source of information for other students. For example, student 4 reported:

> "*Through the discussion after each question, we can share knowledge and ask questions or explain knowledge to other students. If someone doesn't know an answer he can ask more than one of the fellow students to help understand it*".

While the students discuss the information, they can help each other by explaining concepts to those students who do not understand them. This is a new role for students compared to that in the traditional lecture.

2.5.3. Having voice in the lecture

Some students (7 students) stated that PRS based lectures give them more of a voice compared to traditional lectures. In other words, they can ask questions to lecturers or other students instead of just receiving the information. In contrast, students in the traditional lectures sometimes have questions or need to show their understanding of the content, but they did not have the opportunity to ask or discuss anything as the lecturer has the main role, which is delivering the content. Moreover, the rules of the traditional lecture did not allow students to talk without permission, except if they had raised a hand during the allotted questioning time – if there is one.

In addition, 6 lecturers agreed that many students in a PRS lecture felt more able to speak to the lecturer and other students, unlike the traditional lecture, where they feel shy. For example, lecturer 1 stated:

” The *PRS technology has offered students an ability to speak and overcome their stress of speaking to me or to other students. It was common for the students to feel embarrassed merely asking a question in the lecture as they might think it is a stupid question that might result in an embarrassment among other colleagues*”.

This shows how PRS rules have changed the students’ roles and facilitated the transformation of the objectives of the activity. With PRS they clearly have a voice and feel that they form an integral part of the lecture and its delivery.

2.5.4. No changes in roles

Others have explained that there is no change in their roles. 3 students did not feel improvement in their roles. Those students felt active in the traditional lectures as they regularly answer questions and pose more questions of the lecturers. For example, student 7 explained:

“*Using the PRS technology has changed lectures positively. However, I do not feel a massive change to my role as a student during the discussion when explaining my answer to other students, I used to ask questions before and the same now*”.

Thus, they did not feel a big change to their role as they are already active in traditional lectures. Nevertheless, minor changes to their role emerged from the data. Generally, PRS technology has changed students’ roles positively, according to data from both the students and the lecturers these changes have helped students to achieve their learning objectives in a different way. These roles mediate the relationships between students and understanding the content.

2.6. The relationship between the lecturers and PRS

The relationship between the lecturers and PRS was seen as positive by lecturers. This was reflected by different themes extracted from the data gathering tools, as explained below.

2.6.1. The usability of PRS

All the lecturers reported that the system is easy to use and install in their devices, and that it is user-friendly and not complex. For example, lecturer 2 stated:

> "*The system is easy to use. I did not need any training to use it and to apply different specifications. Moreover, the installation for this technology was easy to do either on my laptop or in the computer in the lecture room*".

The PRS is not as difficult to use as other technologies, encouraging lecturers to use it. The ease of use is clearly an advantage in this case, since complexity is often associated with poor implementation of such technologies, leading to poorer results and inefficiency.

2.6.2. Technical Problems

Two lecturers think the only dilemma that arises when using this system stems from technical problems. Technical problems cause a lot of distractions for students and waste time during lectures. For example, lecturer 3 said:

> "*At the beginning, when I started to use this technology, I had technical problems because I did not have a lot of experience in using this technology. These technical problems caused distraction for students and wasted the lecture time. Students lost focus and the environment was not appropriate as a result*".

Although technical problems can be issues for the lecturers, these problems did not happen regularly, as reflected by many of the testimonies collected during this study, but clearly this can be an obstacle

2.6.3. Planning for using PRS

Six of the lecturers stated that they do not lose control of the lecture when they use PRS and that it is easy to keep within the boundaries of the task. Allowing the students to use technology may bring a loss of control over the class. For example, lecturer 3 stated:

> "*I have never experienced losing control while I am using the PRS technology. That might be because I was using a rigorous plan for the lecture to make sure everything will be applied in its time and in an effective way*".

Thus, planning for the activity is essential. Lecture 1 reported that:

> "*Asking questions without preparation for these questions and when they should be asked and the allowed time to answer them causes a loss of control. Usually I feel that when I give time more than it should be*".

However, part of the flexibility of the system to allow the lecturer to produce questions during the lecture (2 lecturers reported that). In many cases, these are questions that came up during the lecture and needed to be asked. For example, lecturer 4 reported:

> "*One of the advantages of using the PRS technology is the ability to insert a question during the lecture to give more explanation for the students*".

Therefore, the relationship between the lecturer and PRS is positive and can help to effectively manage the activity and ensure it is successful. That will increase the possibility of easily achieving the goal of the activity. Based on the data from the lecturers, PRS is a flexible and easy tool to use and helped them to apply the rules and achieve their objectives.

2.7. The relationship between the lecturers' objectives and PRS

In their interviews the lecturers highlighted a variety of objectives in their lectures. For example, improve lecturing, increasing interactivity, increasing attendance, promoting a deeper understanding of the course material, increasing participation, passing the exams successfully and so on.

2.7.1. Lecturers' objectives

The most common or shared objective for the lectures is getting their students to fully understand the lecture content. The data suggests 8 lecturers think their students passing the exams is the desired outcome for the activity and a result of building a deep understanding. For example, lecturer 3 explained:

> "*Using the PRS has helped me to reach the purpose of the lecture which is helping the students understand the content deeply. I believe the deep understanding of the content will help students to pass their exam successfully with a high grade".*

This means that deep understanding is the key objective for the lecturers and the expected outcome from the activity is passing the module successfully with high grades which can be taken as a sign of effective teaching and learning.

Deep understanding was the main objective for the lecturers because it was the most difficult objective for them to achieve in the traditional lecture. The majority clearly think that PRS enhances the achievement of the learning objectives.

2.7.2. Interpretation of deeper understanding

Lecturers interpreted a deeper understanding of the material taught using PRS in different ways. For example, lecturer 1 stated:

> "*Using the PRS helps students to learn new terms accurately through having the questions with choices, discussion after each questions and ability to ask more than the traditional lecturer, this will lead them to understand the content deeply*".

According to lecturer 1, deep understanding reflects a correct understanding of the meaning of new concepts introduced in the lecture. Furthermore, 5 other lecturers agreed with lecturer 1 in this interpretation. Other lecturers (2) defined deep understanding differently. For example, lecturer 3 stated:

> "*Deep understanding can be achieved through understanding the meaning of the concepts and finding how the information in the lecture are related to each other and in turn that will lead to understanding the whole lecture*".

That leads us to define deep understanding as the ability to understand the meaning of the concepts introduced in the lecture and to be able to make connections between these concepts. Lecturer 2 has defined deep understanding as an ability to memorize new concepts. This lecturer teaches biology, so thinks there is much information in that subject that requires

memorisation and deep understanding. From the data, PRS technology was a helpful tool for them to achieve this objective.

2.7.3. More opportunities to achieve the objectives

The objectives cannot be achieved solely by using PRS, but this technology is more important for the effectiveness of the teaching. Therefore, PRS can help the lecturers (9 lecturers agreed) to reach their objectives, depending on the rules of the PRS activity. Using the PRS improperly is not helpful for either the lecturer or the students. Moreover, measuring students' understanding was a difficult objective to achieve in the traditional lecture, as has been previously discussed. Therefore, using PRS was helpful to achieve this objective. It is easy to use and produces results in a few seconds. Moreover, feedback for students' answers can be given during the lecture as the process does not take a lot of time.

Additionally, students can be asked for their preferred lecture delivery or teaching style, which the lecturer can adjust to accordingly. For example, lecturer 2 explained that:

> "*The PRS has offered a suitable tool to evaluate my teaching and I can ask students about their preference, for example, using the PRS individually or with a group and I can arrange my tasks according to their preferences*".

Therefore, evaluating and improving the teaching pattern becomes more possible through the use of PRS with the possibility of choosing a suitable teaching style. When the lecturers started using the PRS technology for teaching, they felt there were more opportunities to achieve their objectives in comparison to the traditional lectures.

2.7.4. The difficulties of achieving objectives

Meeting the learning objectives is essential; however, objectives sometimes might not be achieved for a variety of reasons. The first reason is technical

problems, as mentioned before. Moreover, PRS sometimes causes distractions for students because of unclear or difficult questions. Generally, the lecturers believe PRS is a tool that aids them to achieve their goals. In other words, the system facilitated reaching their objectives, some of which were impossible to achieve in traditional lectures. This can be done through using PRS, applying the rules and improving their relationship with students, as this system is easy to use and can help to implement the activity successfully.

2.8. The relationship between the students and PRS

The relationship between the students and the system as a mediating tool to reach their goals is positive, as reported by both the lecturers and students. This relationship is further explained in the following sections.

2.8.1. The usability of the system for the students

The majority of the students (19 students) believe PRS was an easy tool to use. The students did not face any major difficulties when using PRS. For example, student 13 stated that:

> "*The PRS is easy to use. I can connect the remote device to the receiver easily and I can send my answer without any difficulty, it is rare to find a student who has difficulty with it*".

However, some students (5) reported difficulty in establishing a connection between their devices and the receiver. For example, student 11 explained:

> "*The system is easy to use, but sometimes I cannot make sure if my device connected to the receiver properly*".

Therefore, the system is judged generally easy for students to use. The relationship between the students and the PRS is effected by the way they act in the lecture. The students (13 students) felt PRS has offered them the ability to be

active in the lecture, which has generated a positive relationship between students and PRS rather than merely answering questions.

2.8.2. Difficulties experienced by the students

Some students reported some difficulties in using PRS technology. Two students mentioned that they did not know if their answers were received or not because their answers are not identified or there is no clear indication of their identity. For example, student 6 said:

> "*It is hard for me to know if my answer was received or not, because the system does not tell that except showing the number of responses*".

This is considered one of the disadvantages of the system as it is difficult to know if the answers were received or not.

Moreover, many students (17 students) reported that the technical problems sometimes do not encourage them to participate. For example, student 10 stated:

> "*The only disadvantage of using the PRS I can think of is the technical problems, because I got distracted every time a technical problem disturbed the lecture*".

Technical problems can be the main issue effecting the whole activity and effecting the involvement with and participation in the learning process.

Moreover, some students noted that the way the system is used is more important than the features of the system itself. From the data, it can be clearly seen that PRS is useful for the students and offered them a valuable role in the lectures. Therefore, the data showed an effective relationship between the students and the PRS technology. This relationship has improved the relationship between components of the PRS activity

2.8.3. The number of questions

The number of questions depends on the length of the lecture and the amount of content to be delivered, which is not possible to change based on university policy. However, lecturers need to plan accurately for using PRS in lectures. 2 lecturers reported the optimum number of questions should be between 3 and 5 in one lecture. Asking this range of questions will allow time for discussion between students and give more time for explanations or addressing any misunderstandings. Many lecturers (7 lecturers) said the number of planned questions should match that average, however, adding pertinent questions during the lecture must be considered. For example, lecture 3 noted that:

> "*The number of questions should be between 3 to 5 questions as reasonable number for the time of the lecture, but sometimes I need to add some questions to measure understanding some concepts again, especially, if the percentage of the wrong answers was high*".

On the other hand, lecturers 4 and 8 believe the number of the questions should not be more than 3 questions in one lecture. They justified their opinion by saying that the time and the content only allowed time for 3 questions. Asking enough questions in the lecture will help students measure their understanding of and find connections between the concepts. Overall, lecturers are best be prepared to decide the appropriate number of questions used in the lecture. This clearly depends on the difficulty of the questions and the material delivered.

2.8.4. Using PRS individually or with groups

Deciding how to use PRS is important, be it individually or as small groups. This largely depends on the number of students involved in the lecture. For example, lecturer 3 stated:

> "*Using the PRS with a small number of students will help the lecturer to use the PRS individually or with a group*".

Only one lecturer disagreed with that, because he believes the system should be used individually only, irrespective of the number of students. On this subject, lecturer 1 suggested that:

> "*The number of students does not make a big difference because every student will have his own device and I can apply all the other rules without effects from the number of the students*".

Moreover, a few students (6 students) think using the PRS within a small group can be more useful as they can share knowledge and explain things to each other. For example, lecturer 4 stated:

> "*Using the PRS as a collective activity is an effective way to keep the activity interesting for them. However, the number of students does not help to apply the PRS as a collective activity*".

Several methods of PRS use were preferred by participants. Nevertheless, it is believed that using the PRS during the lecture is more beneficial for the learning process.

Fundamentally, it is believed that the rules for using PRS are essential and must be flexible to fit every situation in the educational environment. The rules of the PRS activity are a vital factor. Through the rules the lecturer will be able to run the PRS activity effectively and play an efficient role in the classroom.

2.9. The relationship between PRS and rules of the activity

The adopted rules for using the PRS should be appropriate for the purposes of the learning activity and for the PRS system specification; as it was mentioned in the literature, some offer only one type of question and others offer different types of questions. For example, if we are going to ask students to give comments about a topic, then we need to have open-ended questions to receive their comments. This refers to affordance theory as the specifications of PRS should correspond with the rules of the activity. Using PRS in an inappropriate way or at an

unsuitable time may have a negative impact on the educational context. For example, using PRS as collective activity with a large number of students may lead to a loss of control. For example, lecturer 3 stated:

> "*I have used the PRS as collective activity and the number of students was 68 students. I felt it was difficult to control the activity. Many students start to talk and other students did not participate with their groups. Therefore, I think the PRS should be used individually in my lecturers*"

An improper PRS strategy may effect the benefits of the system and lead to a more negative experience for participants.

2.9.1. Using PRS in all subjects

Determining the suitability of PRS for each subject was determined through the data. The students reported that PRS is suitable for all the subjects they studied and is sufficiently flexible to be used during many different lectures. 18 students believe PRS can be used in all subjects as it possible to ask these types of questions in all subjects. Only 2 students think PRS cannot be used to ask questions in some subjects, like biology. The reason for this is that biology covers a lot of information in one topic which means questions should be open-ended to include more information. For example, student 4 stated:

> "*When we have a question in biology as a Multiple Choice Question it is not suitable to have short answer, so I think having open ended question might be more useful to write my understanding of any concept in more details*".

Nevertheless, the lecturers think it is possible to use PRS with all the subjects, but it could be more helpful to use it with a variety of questions to allow students to express their understanding. For example, lecturer 1 explained:

> "*The PRS with its specifications can be used in every subject, however, adding open ended questions features can be more useful for the learning process. Through the students answers I can make sure the answers were based on their understanding not guessing the answers*".

Therefore, PRS is suitable for most of the subjects, but it will be more valuable to add an option for all types of questions to be constructed.

Generally, the rules of the PRS activity are compatible with the PRS's features and facilitate relationships between individuals in the classroom. This relationship between PRS and the rules of the activity influences the relationship between the lecturer, students and PRS to achieve the learning objectives.

3. Influences of PRS on students' experiences

In this section the second research question will be addressed, which enquires about the way PRS influences students' experiences in the educational environment. Open codes were chosen to reflect the students' responses to the questionnaire and group interviews and the lecturers' interviews. The codes and categories will represent the most important influences of the PRS in the students' experience, as identified by the participants in this study. Examples of these categories are participation, understanding, and interaction. Participants reported that introducing PRS has positively changed the students' experiences in some respects as result of the improvement in relationships and ability to achieve the learning objectives of the activity. Nevertheless, the way of technology is used can also negatively effect students' experiences. These effects may affect the learning process and the relationships between the components of the PRS activity, as will be explained in the next section.

3.1. Participation

Lecturing in a large auditorium is one of the challenges a lecturer faces in the traditional lecture. The large class size means students may not know each other personally and there is normally a long distance between the front and last row of students, meaning there is no relationship between the students in this lecture

format (Trees & Jackson, 2007). This may increase anxiety about participating verbally, as the students must speak in front of people they do not know. Hence, the relationships between students and between the students and the lecturer are important to increase participation. This relationship helps to run the activity effectively and offers students opportunities to become involved in the learning process.

3.1.1. More opportunities for participation

The format of the traditional lecture made students feel isolated from the learning process. In the group interview 20 students reported that they have more opportunities to participate and engage with this technology. For example, student 16 stated:

> "*Introducing the PRS has offered me an opportunity to get involved in the lecture. I have my own device and I can answer the PRS questions while working with other students*".

Every student has their own device, encouraging them to participate and play a new role in the lecture. Throughout data collection, the students identified an increase in participation in different ways. 13 students see their participation increase through their ability to become more involved in answering the questions. Other students (6 students) see their participation increased when they discuss answers and ask questions of other students or lecturers.

This has encouraged students to play a new role in that context. For example, student 14 explained:

> "*I was required in the traditional lecture to remain calm during the lecture, but now with the PRS I am required to answer the PRS questions and discuss my answers with other students*".

Therefore, using PRS has changed the students' roles, involving them in the learning process. This can be related to AT, whereby students and lecturers create more opportunities to achieve their objectives by changing their roles. Only 4% of the participants disagree, and this may be accounted not applying the rules for the activity properly. For example, student 2 stated:

> "Not giving sufficient time to answer a given question *will affect my ability to participate and choose the right answer and that could be a major problem as I get frustrated*".

This further emphasises that the relationship between the students and lecturers is mediated by the rules of the activity.

3.1.2. The changes in the lecturers' role increases participation

The lecturers' role has changed when using PRS, helping students to become more engaged in the learning process. Examples of these changes are asking questions and giving immediate feedback to students. For example, lecturer 3 reported:

> "*Showing the answers for the students is powerful way to measure the students' ability to identify the right answer and give immediate feedbacks for them to correct their views and the knowledge they have and that's the main concept of teaching"*.

Therefore, improvements to the relationship between the students and the lecturers in the PRS activity has improved participation.

3.1.3. Anonymous answers

Answering anonymously is a vital factor in increasing student participation. Many students might feel intimidated by asking or answering questions in a traditional manner. For example, student 13 stated:

> "*Using the PRS anonymously is an advantage of this system because I will participate and I will not be embarrassed in front of the other student if I make a mistake*".

The students can participate in the learning activity and interact with the lecturer without fear of making mistakes or feeling embarrassed by their answers. Many students in the questionnaire were positive about this feature (see Tables 9 and 10). The majority of students do not want to be seen as weak or less knowledgeable in front of other students. They make mistakes by giving the wrong answers or failing to understand the questions because they are in English. Nevertheless, 2 students preferred to be identified in order to know whether they chose the right or wrong answers. For example, student 10 reported:

> "*I find answering the questions anonymously is a good feature sometimes, but generally, I prefer identifying the answers to know who chose the wrong or right answer, because that will give me assurance to ask the right students*".

This can be a cultural factor, as more focus will be on the students who preform less and they will be seen as not intelligent students. This view is common in the Saudi context. Some students (8) said in the group interview:

> "*It is better to keep silent if you don't know the answer, to not be exposed in front of other students that could cause embarrassment*".

Because they do not want to make mistakes in front of their peers and fear they will lose respect when they make trivial mistakes. Therefore, anonymously answering with PRS can be a solution for these cultural dilemmas. They see the anonymous voting as a useful feature.

3.1.4. The English Language

Several students (16 students) reported that in the traditional lecture the English language was a challenge limiting their participation, but with the PRS they are more confident to participate. In fact, English hindered the improvement of the relationship between students and between students and their lecturer. The majority of the students prefer not to participate in the learning process because they are unable to speak in English. For example, student 14 stated:

> "*The reason for not participating is because we do not need to speak or participate verbally and we have more time to understand the meaning of the question*".

All the lecturers (9 lecturers) agreed the system has increased students' participation. For example, lecturer 1 explained:

> "*Using the PRS has changed the way students act in the lecture by making them involved in the lecture more than before. That involvement included answering questions, interacting with other students*".

The students have more opportunity to participate than in the traditional lectures. Participation is a part of the learning process towards reaching deep understanding in the PRS activity. Activities without participation will be similar to traditional lectures. Therefore, learning using PRS as mediating tool and the relationships between the components of the activity have both helped students increase their participation, as reflected in the data.

3.2. Attention

Increasing students' attention has been one of the main concerns for the educators. Attention has been defined as the ability to get the mind to focus on a process or situation and is a condition for learning to take place (Sylwester & Cho, 1993). Students' attention is driven by motivation. In the traditional lectures, the students did not have real motivation, because they attended the lecture to listen to the information, often without doing any activity.

3.2.1. Increasing attention

PRS technology was a helpful tool for the lecturer to increase attention in class. The students felt they can pay more attention when using PRS technology. The way the system works helps increase students' attention as they engage in the session (14 students). For example, student 6 stated:

> "*By using the PRS, I felt more motivat to concentrated during the lecture, because I need to choose the right answer for the questions, also I pay attention to others and what they answer so I can learn from them*".

Students need to keep concentrating during the lecture to be able to understand and answer the questions; therefore, through asking questions during the lecture the students will be motivated to concentrate. Questions can occur at any time during the lecture promoting further concentration as students want to be prepared.

3.2.2. Distraction by other students

The relationship or interaction between the students themselves during the lecture might be a distraction in the PRS activity. Some students (5 students) did not cooperate because they felt it PRS makes responding into a competition because when some students did not understand some terms of a question, they tried to ask other students for help but they refused or do not cooperate. Therefore, those students who did not understand become distracted because of this reaction from other students. For example, student 13 reported:

> "*Sometimes I got distracted because of the other students; they made me nervous because they did not help me or give any explanation for some questions or concepts in the lecture. Sometimes they discuss the answers and that confuses me*".

Moreover, some of the lecturers (5 lectures) noticed that when the students did not cooperate with each other, some students got distracted and could not concentrate. Thus the relationships between students may impact the achievement of the learning objectives.

Based on the data, it is clear that the relationships between the students and the lecturer and between the students and the rules of the activity have important roles for increasing attention using PRS. These relationships and rules may cause negative effects on the students' attention. This relates to AT as the

relationship between the components of the activity are essential to transform the learning objectives to outcomes.

3.3. Interaction

PRS can enhance interaction, which is described as a two-way influence between the lecturer and students (Dagarin, 2004). This interaction can be processed as cooperation between the participants or affected by their attitudes or the relationships between them. This experience has become more positive, as the students mentioned in their responses to the questionnaire.

3.3.1. The format of interaction

The formats of interaction in the PRS lectures vary. The most common pattern of interaction in the PRS lecture is the lecturer posing questions for the students to answer. This behavioural pattern was not possible for all students in the traditional lecture; usually one or two students interacted with the lecture and the rest stayed passive because of the nature of the rules in the traditional lecture (12 students reported this). For example, student 18 explained:

> "*In the traditional lecture, I tried to avoid raising my hand because I do not want to speak to the lecture, because I am not used to do so*".

Therefore, introducing PRS gives students the chance to answer questions. Introducing PRS technology has improved the relationship between the students and their lecturer and improved their interaction as a result. The lecturer became more familiar with asking questions and the students became more familiar with receiving and answering questions. For example, student 4 stated:

> "*The PRS encouraged me to get involved and interact with others in the lecture"*

This sentiment was echoed by 14 other students in the study. Additionally, lecturer 2 stated:

> "*With using the PRS I become more able to ask questions with the majority of the students and receive their answers rather than the traditional way in which only a few students are known to be willing to answer*"

This idea was reported by 7 of the lecturers. Hence, using PRS has an influence on the interaction between the students and their lecturers in terms of asking questions and allowing students to answer.

The second pattern of interaction between the lecturer and students is giving feedback to students or the students asking questions of the lecturer. The students' task is to answer the questions, while the lecturer follows this up with feedback or more explanation. This form of interaction was not available in the traditional lecture due to the nature of the roles for each participant; the lecturer was expected to explain and students to listen. For example, student 1 explained:

> "*In the traditional lecture, we are only listening to the information. We did not have opportunity to participate, express our opinion, measure our understanding and correct any misunderstanding*".

Therefore, the influence of PRS on the roles of the lecturers and students has increased their interaction compared with traditional lectures. This is a positive influence as all parties get involved in the session, which promotes better interaction.

The third pattern of interaction in a PRS lecture is the interaction between students. In the traditional lecture there was no interaction between students. Again, introducing PRS technology has changed the role of students and their relationships. For example, student 7 stated:

"*With the PRS technology, it is part of the activity to ask other students and they need to justify their answers*".

Essentially, it is clear that using PRS has changed the role of the students from passive to active members in the learning process, increasing their interaction. Students interact with each other by asking questions to understand the PRS questions before they choose the right answer.

3.3.2. No changes to the level of interaction with PRS

Further details showed that only two students did not see many changes in the interaction in the lecture. The justification for this opinion is that they think they are good students and they are the most participating students in the traditional lectures and answer most questions. For example, students 10 stated:

"*I felt introducing the PRS has not changed the level of interaction for me because I usually ask the lecturer and answer his questions and I ask other students if I do not understand anything*".

However, the majority of the participants believe the level of the interaction has increased remarkably with using the PRS.

Nevertheless, that level of interaction is unstable because of how the rules are applied and the occurrence of technical problems. When rules are inappropriately applied the level of interaction will decrease and students will not be able to interact as result of the difficulties they face.

3.3.3. Preparation for the class and understanding

The influences of PRS on students' experience may come in the form of increased preparation for the lectures and a deeper understanding of the topic. Educators believe reading before coming to a class will help students to learn and follow the material better, prompt them to ask more suitable questions and get involved in the learning process (Heiner, Banet & Wieman, 2014), "*Piaget*

emphasised the importance of the prior experience and knowledge are important for learning to occur" (Austin, Orcutt & Rosso, 2001).

3.3.4. Lecture preparation

Some students (7 students) reported that PRS encouraged them to prepare for the lectures in advance to be able to participate. This also resulted in a deeper and better understanding of the lecture content. For example, students 4 stated:

> "*Using the PRS has encouraged me to prepare for the class to be able to participate and to choose the right answers. In addition I need to justify my answers for the PRS questions*".

This preparation was vital to encourage students to understand the content of a given lecture. Perhaps students feel the pressure of having to answer questions during class and as a result they prepare to be able to participate better.

3.3.5. Defining deep understanding

The understanding and comprehension of topics is one of the most important objectives for students and lecturers. They attend the class and take active roles in it to reach a deeper understanding. The data suggests students interpret this term in different ways. For example, student 3 stated:

> "*With using the PRS we can understand more, through understanding the new meaning of the new terms by asking other students or the lecturer. And when visually seeing the answers we might understand better*".

This understanding was also communicated by 6 other students. Many students struggle to understand English since it is their second language; they were not able to understand the meaning of every point. This is because in medical subjects, each new point comes with many new terms. If a student did not understand the meaning of that point, they were less likely to understand the lecture as a whole. Therefore, the meaning of the new terms posed a challenge

for students in traditional lectures. PRS offers them the opportunity to ask about such terms, either asking other students or their lecturer.

Additionally, many students (17 participants) said each question they answer moves them forward towards a better understanding of the whole content of the lecture. They reported it was not easy for them to understand the content or make connections between the concepts of the lecture in the traditional format because the lecture is too long and there is a lot of information given in a short space of time. With PRS, they can make connections between the concepts of the lecture with the PRS questions and discussion. For example, student 11 stated:

> "*The lecturer asked many questions during the lecture using the PRS technology, usually these questions for the most points. We can make connections between these points and the topic of the lecture. That helps me to understand the whole lecture*".

Therefore, the PRS technology and questions work as an aid to increase their understanding, as reported by 17 students. By offering opportunities for students to make connections between the most important points in the lecture, they were more able to understand the content. The discussion and feedback after each question are helpful to correct any misunderstanding or mistakes and gain a deep and accurate understanding of the content, as reported by 13 students. For example, student 14 reported:

> "*Using PRS is helping me to understand, but what is more important is offering time for discussion and feedback after each question so if I get the wrong answer initially I will have time to correct and discuss it*".

The reason behind the agreement with this statement may be because they have to think deeply about what they are going to say, how they organise the information and how they link it to other information, which is confirmed by the

data from the questionnaire. For example, in the group interview, student 16 stated that:

> "*Having discussion after each question helps me to listen to other students' clarification and learn from that. In addition when I explain my thought to other students I need to think deeply and organize the information and make connections between the current concept and the previous information in the lecture"*.

The students will spontaneously try to make connections between the information and understand the meaning of the concepts to be able to explain their thoughts to other students, thus understanding is constructed through their relationships and interaction with other students.

Moreover, this will allow students to communicate with each other and play different roles to achieve their learning objectives. Student 11 reported:

> "*I could learn from another student during the activity more than the lecturer, through asking other students about their answers and how did they choose the right answer and he can justify that. For me it's easier to ask other students more than asking the lecturer, we think similarly and we use simple language*".

The data from the group interview supports that statement as the students' explanations were helpful to the other students to learn new material and clarify existing knowledge.

The affordance of PRS enables students to measure their understanding and correct any misunderstandings. For example, student 2 stated:

> "*Showing the result of our answers is a vital feature that enables me to work to increase my understanding by asking the lecturer or other students to clarify and explain the correct answers*".

That offers students a new role regarding their ability to measure their understanding in the lecture and work to increase it to reach their objectives. Based on the findings, PRS clearly enhances students' understanding of

The materials, as illustrated above. It can be clearly seen that the relationship between the components of the PRS activity is key to achieving the learning objectives.

3.4. Confidence

In recent years, a number of studies showed that the number of students and the size of the lecture rooms have an effect on students' confidence and thereby affected their performance and achievement (Suchman *et al.*, 2006). Throughout the data are instances where confidence was improved by using PRS. This evidence was noted in responses from both lecturers and students.

3.4.1. Increasing confidence

In the group interview, some students reported (11 students) that they are more confident at getting involved in the learning process in different ways when using PRS. One method that required a high level of confidence was the ability to answer questions and discuss their answers with other students. For example, student 8 reported:

> "*Using the PRS made me more confident to participate because I was encouraged by the way of using the system and seeing other students involving in the learning by answering the questions and discussing the answers".*

Seeing other students being involved in the learning process encouraged their peers to overcome any fear or embarrassment. In the traditional lectures, the students avoided being involved in the learning process because of the restrictive rules of the traditional lecture and the students' roles.

3 lecturers said the students' confidence has improved by participating in the learning, answering the questions and discussing their answers. For example, lecturer 1 stated:

> "*In the traditional lecturer the students did not have an opportunity to participate because of the number of the students. Moreover, the majority of students have a fear of the participating because they will speak in front of other students and they may give wrong answer. Through using the PRS, I felt they were more confident because all the students were required to answer the questions and discuss their answers. Therefore I believe students are more confident to involve more in the learning*".

This explanation shows how introducing PRS and applying the rules for the activity has increased students' confidence by making them more familiar with involvement in the learning context. In other words, a lack of encouragement to get students involved in the learning context will have a negative impact on their confidence, as in the traditional lecture. For example, student 13 reported:

> "*I didn't feel encouraged in the traditional lecture to get involved in the learning, I felt like I have to listen only so I preferred not to be involved because I am not encouraged to do so and the majority of the students were doing the same by not participating*".

Therefore, the rules of the PRS activity have made the students more confident in their involvement in the learning.

Fundamentally, one of the main reasons for the students' poor confidence was the lack of communication between the lecturer and students, and between the students themselves. As a result, they lacked the confidence to ask questions when they struggled to understand a new concept. For example, student 2 reported:

> "*I think we were not able to ask each other or interact, because we do not know each other or we do not talk. In every lecture I sit on a different seat beside another student and keep concentrating with the lecturer without any opportunity to talk*".

3.4.2. Offering discussion increases students' confidence

7 students from the interview group have reported that the opportunity to have a group discussion increased students' confidence, allowing them to communicate with other students. For example, student 3 stated:

> "*Through using the PRS and given an opportunity for me to discuss my answers with other students, I became more confident to communicate with them during the lecture or after the lecture and ask any question as they became more familiar for me*".

That discussion promotes students' confidence was reported by 5 other students.

Although the system has increased the level of communication between the students, the lecturer may cause some limitations by not offering enough time for discussion. For example, student 11 stated:

> *"The lecturer sometimes did not offer time for discussion, so I felt less confident about the knowledge I learnt during the lecture. Moreover, I felt less confident because we did not discuss our answers and we did not receive feedbacks from the lecturer*".

Clearly discussing the material improves confidence, and lecturers can have either a positive or a negative impact on these discussions; opportunity and time will increase discussion and confidence.

3.4.3. Reducing fear of making mistakes

Many students (14) reported the main reason for their shyness or lack of confidence in the traditional lecture was shyness. Students reported that this barrier has been broken by using the PRS. They feel more confident about participating and asking questions, especially when PRS was used anonymously (see Table 10).

17 students reported that they no longer fear making mistakes as they will not be identified. For example, student 14 stated that:

> "*Using the PRS to participate has reduced my fear of making mistakes, all the students will participate and no one will know what my answer was? so I have no reason to feel shy or embarrassed if I make a mistake*".

However, 3 students said the system may have a negative impact on their confidence. For example, student 16 stated:

> "*Showing the answers is fantastic feature, nevertheless when I choose a wrong answer I felt less confidence to get involved in the learning activity or discussion*".

They felt that when they find their answers are wrong, they do not feel as good as the other students or need to work a lot harder to reach another students' level. Therefore, PRS was a vital element to improve students' confidence. This improvement occurred through better communication, greater involvement in the learning process and helping students to understand English terms more fully. Although the majority of participants agreed their confidence has improved, three students reported they felt less confident when choosing a wrong answer.

3.5. Improving English

One of the barriers experienced by the students in the traditional lecture is getting involved in the learning when they lecture was conducted in English. Many students are unsuccessful academically because of a low level of English, and because lecturers relied on delivering the lecture without interaction in the "old format of lecture" (Oluwole, 2008). The old method, called colloquially "chalk and talk" (Agbatogun, 2014), consisted of the lecturer talking to their students to deliver the information while their students take notes; this form of passive learning and less communication did not allow students to practice expressing themselves in English. At King Khaled University (KKU), all the lectures are taught in English though most of the students have poor English skills. Many students (17 students) felt their English language skills are low and that they do not understand many concepts because of that. For example, student 9 stated:

> "*Because all the lecturer in my course are delivered in English, I faced difficulty in interacting in the lecture and understanding many concepts*".

As the spoken language for the students is Arabic many lecturers (8 lecturers) have noticed the majority of the students avoid interacting with them. For example, lecturer 2 stated:

> "*In the old format of lectures, the students struggled in understanding many concepts and as a result avoided asking me or answering any questions, because of the low level of English language skills*".

Therefore, in the traditional lectures it was difficult for the students to communicate and interact during the lecture. Clearly English is an obstacle for students in Saudi Arabia.

3.5.1. Solution for the English language difficulty

Introducing PRS technology provided a solution for this difficulty by offering a strategy for interaction, involvement in the learning and learning more English terms. 17 students reported that the system has facilitated communication between the lecturers and students, and they now understand many more English language terms. For example, student 18 reported:

> "*Through using the PRS, I can receive questions and have time to translate new terms or ask other students about the terms. That helped me to understand many English terms and has improved my English language skills*".

Their understanding of the content has increased by understanding the meaning. Group discussion and interaction with the lecturer clearly helped in facilitating understanding of the new terms.

Additionally, 8 lecturers believed the students' understanding of the content and English language skills have improved. They believed the students learned many English terms during the PRS activity and improved their communication and understanding. For example, lecturer 1 explained:

> "*The students in the PRS lectures got over the difficulty of the English language, by learning many English terms through using PRS during the learning process*".

Nevertheless, one lecturer (lecturer 3) reported:

> "*I believe the students learned many English terms during the lecture, but they still avoid asking me questions or answering questions verbally. The reason for that is because they were not confident enough to speak in front of me or other students in English*".

The lecturer believed that because the students learned new terms, but their ability to communicate with him did not improve when they were asked to answer questions verbally in English.

3.5.2. Improving English language skills hindered by PRS

The improvement in English language skills might not always happen because of constraints during the lecture – for example, not offering enough time to answer questions nor offering time for discussion. The majority of the students (14) reported that they were not offered enough time during the activity, which did not help them learn new English terms. For example, student 8 stated:

> "*During the PRS activity we learn many English terms and apply these terms during the discussion with other students, but sometimes we don't have time to translate or to apply these terms during the lecture*".

The opportunity to improve English language skills has increased with the use of PRS technology, but that relies on applying the rules of the activity. If the rules of the PRS activity are properly applied the students will have more opportunity to improve their English language skills.

3.6. Motivation

Motivation is a generic word that can be used in different contexts. In an educational context, it has been defined as a condition where students are stimulated to act based on tangible or intangible factors (Williams & Williams,

2011). In the traditional lectures there was no real motivation for the students to attend or contribute to the lecture. In Higher Education student attendance can decrease and the main reason for that is a lack of motivation for students to attend (Muir, 2009). This is partly because of the way the lecture was conducted as the changes to the lecture format with PRS increased student motivation.

3.6.1. Motivation to attend lectures

PRS has encouraged some students (13 students) to attend and participate in lectures. Moreover the traditional lecture was boring according to many students, so some students did not attend as they had access to the PowerPoint slides on Blackboard and felt the lecturer might not add too much to what exists in the slides. For example, student 7 stated:

> "*I was attending in the traditional lecturer a few times because of the exams or to have notes from the previous lectures*".

The PRS activities provided motivation and fun for most of the students. For example, lecturer 1 said:

> "*The poor percentage of the attendance in the traditional lecture was a dilemma for me, because many students are not attending the lecturers will not be able to pass the module. Therefore, increasing attendance became an object for me but it was difficult to achieve in the traditional lecture, unless I use marks for that. When I started using the PRS the percentage of attendance has changed from about 40% to 85%*".

Therefore, using PRS has helped many of the lecturers (7 lecturers reported this) increase attendance in their lectures, as students are more motivated to attend and participate.

3.6.2. Motivation for students as fun

15 students described the PRS activity as a fun activity; they enjoyed using it. For example, student 2 explained:

> *"Introducing the PRS technology to some lectures made students be motivated to attend these lectures more than the traditional lectures, I got more excited by using the PRS as we can act and involve in the learning*".

The students compared the lecture with the PRS to the traditional lecture. In the PRS lecture they could receive and answer questions, which they enjoyed. Additionally, the lecturers (3 lecturers) reported the students were enjoying using PRS and they got excited. For example, lecturer 4 reported:

> "*Students enjoyed using PRS, The PRS motivated students to attend more than the traditional lecture because they enjoyed using the PRS*".

Using this technology has a positive influence on student attendance and active participation. The motivation here was enjoyment.

In their interview the students reported that PRS has changed the relationship between them to something more competitive. 9 students said they were more motivated to attend and participate because they enjoyed competing with their peers. Though in some subjects there were assigned marks for attending or participating in the lectures, a few students (6 students) felt they attend more regularly and get more involved to gain marks. For example, student 18 stated:

> "*In some lectures we excited marks to participate or attend these lectures, but with that I do not feel exited to attend because we have the same routine every lecture. In the PRS activity I enjoyed competed with my peer to see who will have the majority of the answers correct*".

3.6.3. Increased motivation and lecture atmosphere

A few students (5 students) believe they were more motivated with PRS because they saw other students actively participating in the lecture, which encouraged them to do the same. For example, student 5 stated:

> "*Seeing other students actively participating made me motivated to act like them, so I got involved to take part in the learning process because I found it encouraging*".

Both lecturers and students believed PRS was a vital motivation for students to change their behaviour compared with the traditional lecture. One lecturer said PRS technology has changed the educational environment. The students have more fun with PRS than in the traditional lectures.

3.7. Learning outcome

According to many studies the learning outcome refers to the final grade of the taught course (Zhonggen & Liu, 2014). Other studies defined the learning outcome as the ability for the students to acquire knowledge, and to apply and analyse information (Bousbahi, 2014).

3.7.1. Improving students' marks

In the current study, the process and the time put aside for collecting data did not allow me to track the students' marks in their final exams, as it took place over one term and I did not seek authorization to access the students' marks. Nevertheless, students reported that their marks for the weekly exams improved as a result of PRS use. For example, student 7 explained:

> *"The PRS was beneficial for me as my marks have improved in the weekly exams, so I would say it has improved my marks".*

This perspective cannot be generalized to the entire sample because only 3 students reported it. Based on the data from the interviews the students reported an improvement in different aspects of the second category of the learning outcome.

3.7.2. Changing the level of learning

11 students mentioned that in the traditional lecture they were memorizing the information after the lecture as a way to understand the content. For example, student 12 stated:

> "*Meaning used to memorise the materials and sometimes that did not guarantee an understanding, however that has improved with PRS*".

With PRS, they had more opportunity to build a deeper understanding of the content and memorize the information through improving their relationships with each other and discussing their answers. Moreover, some students (16 students) reported that within the PRS activity, they are more able to make comparisons, apply some concepts, analyse information and evaluate its value. For example, student 3 stated:

> "*With the PRS there is more possibility to memorize the new information during the lecture; additionally I can make comparison between the categories of the blood and the common blood diseases, when I explain my answer to the other students*".

That conclusion was reported by 8 students and demonstrates how learning improved after using the PRS technology. Comparing new information is more useful than trying to memorize it, as they did in the traditional lecture. However, this perspective cannot be applied to all the students as only a few reported it. Other students gave different explanations for their improved learning progress. Some students (6 students) reported that their ability to apply and analyse the new concepts was higher with PRS than in the traditional lectures. For example, student 5 reported:

> "*Throughout the lecture, I can concentrate more, answering the PRS questions and discussing the answers after each question. That process is helping me to increase my ability to apply some concepts, for example, identifying the type of bacteria, and finding the treatment for what it causes*".

The lecturers' explanation and use of PRS technology increases the possibility of students to be more able to apply the new concepts to real life. Moreover, the ability to analyse the concepts became more possible for some students (2 students reported this). For example, student 16 reported:

> "*Through the discussion after each question, I am able to analyse many types of the bacteria. That analysis include the name, colour and what diseases may cause for the human*".

That level of learning was not possible for the students in the traditional lecture. In the past, students were learning at the low level by "memorizing the information"(Alfahad, 2012). Furthermore, some students became more aware of the value of the concepts in each lecture. In other words, the students felt the information they received during the lectures was important for their future careers and lives (3 students reported that). For example, student 10 explained:

> "*Through using the PRS technology, we are able to make connections between the information and the topic for the lecture. That led us to value the information for my future job as doctor and my normal life*".

Generally, the relationship between the students and their objectives shows achieving the objectives becomes more possible with PRS. This was influenced by the relationships between students and their lecturers.

4. Conclusion

In this chapter the answers to the main research questions have been presented from the qualitative methods. A number of interesting findings were generated through the data from the students and lecturers regarding the use of PRS in HEIs in Saudi Arabia. Clearly the advantages of this system are enormous compared to its disadvantages. With the PRS system the relationship between the lecturer, the students and the learning activity are largely seen as a positive compared to the traditional learning process, where students are passive learners and the lecturer is in control. The dynamic of the learning process was mediated by PRS and controlled by the rules. It was reported that the learning was based on memorisation in the traditional lecture format, but with PRS the learning has changed to constructivist learning where the students and lecturer interact with

each other. The learning is constructed through the PRS questions and the interaction between students, and between students and lecturers.

The findings show that teaching with PRS has changed from only delivering the content to guiding the learning for the students. Here, the lecturer poses a question and allows students to answer, offering time for discussion afterwards. The final step is feedback from the lecturer to correct any mistake or misunderstanding. This process happens during the lecture to help to construct student understanding, which is the preferred learning method for the students and totally different from the learning method in the traditional lecture. Nevertheless, the use of PRS might create a distraction in some cases, for example, an inappropriate use of PRS or technical issues. The roles in the PRS activity seem balanced where all parties are equally involved. Although the results were discussed here, the following chapter will concentrate on summarising the outcomes with regard to each of the research questions from qualitative findings and quantitative methods, while including recommendations for better use of PRS and research limitations.

Chapter7: Discussion

1. Introduction

This chapter will discuss the findings of the current study in an attempt to link them to the research questions in order to develop a better understanding of the role played by PRS in an educational context and also in relation to the student-lecturer relationship. Additionally, the implications of using PRS as an educational technology in the light of AT will also be discussed. This chapter will summarise the findings in line with the first and second research questions, followed by an overview of the implications of this technology on HEIs in Saudi Arabia, using KKU for the case study. The implications of this will represent the answer for the third research question.

2. The impact of using PRS in an educational environment

Following data analysis, it was concluded that PRS has had a positive influence on the educational environment. Nevertheless, there were also some negative impacts of using the system and this effected both teaching and learning. Positive changes to the learning activities and the mechanism of learning through the relationships between students and their lecturers, and between students themselves were observed. Additionally, the rules of the activity and the roles of the individuals taking part in the activity have generally changed positively, with some negative effects in some cases. Morling et al. (2008) also reported the positive impact of technology use as part of the teaching and learning process. Similarly, and with specific reference to the use of PRS, Stagg and Lane (2010) and Patry (2009) reported a positive influence on students' engagement level in the classroom. According to AT, to achieve objectives, there is a need for relationships and interaction between the components of the activity (Engeström, 1993). These relationships will generate a transformation from an objective to an outcome. Nevertheless, the data in this study revealed some differences between

the lecturer and students in terms of objectives, roles and rules for the PRS activity. Therefore, these differences suggest the existence of two activity systems in general. The first activity system is for the students, while the second activity system is for the lecturers. In order to understand the reality and practical implications of using PRS in Saudi Universities and also to have a better understanding of the findings that relate to the relationship between the subject and objectives, ideal type activity systems are used to summarise those findings that are most representative for both the students and the lecturers. The generated activity systems will show the ideal use of the PRS by the participants and it will be compared to the actual and sometimes unsuitable use of PRS at KKU (Bruun, 2012).

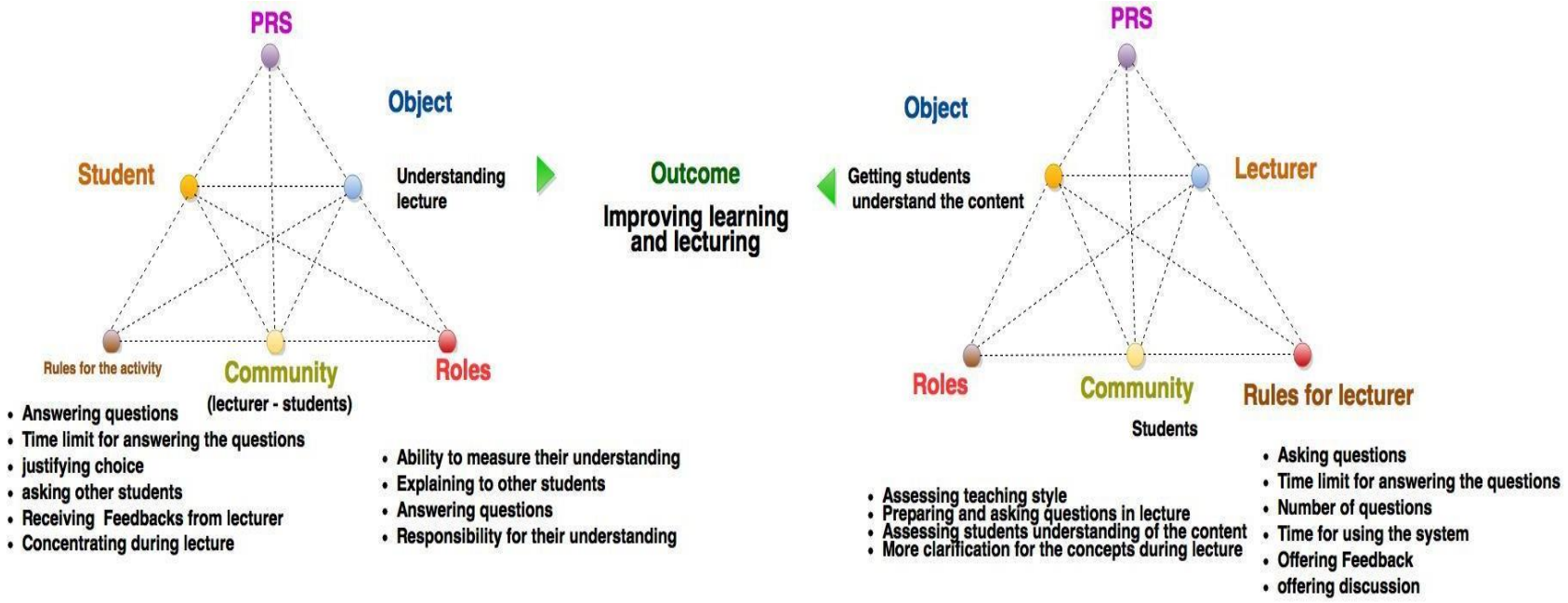

Figure 25 PRS activity with all the details from the findings

Each activity system shows the ideal use of PRS by students and lecturers with different components involved. The ideal activity system for students shows how the PRS activity should be used by students and lecturers to allow transformation of objectives to completed goals. Generally, there are differences between both activity systems in terms of rules, roles, and objectives, based on each participant's position in the class as the teacher wants to deliver the information and the students want to learn and construct their understanding of the content. These differences are vital to achieving the objectives of the activity for both groups. The students' activity system shows their objective is to develop an in-depth understanding of the content through the activity. This objective can be achieved through each individual fulfilling specific roles but with some different rules. Their roles include answering questions, assessing their understanding, explaining to other students and taking more responsibility for their own understanding. Moreover, the rules for their activity include answering questions, not exceeding the time limit, justifying their answers to the lecturer or other students, receiving feedback and asking questions to the lecturer, seeking feedback from other students and concentrating during the lecture. The students' activity system represents the idea that any relationship within the community (students and lecturer) is mediated by rules. Based on the findings their activity objectives are mostly concerned with working in class to deeply understand the content. On the other hand, the lecturers' activity system differs from the students' activity system in many aspects. Hence the idea that learning activities are a form of social activity is strongly supported by AT and further emphasised in the current study.

The activity systems presented in this chapter are what the sociologist Max Weber calls ideal types. By ideal he does not mean perfect things or moral ideals;

ideal refers to the world of ideas, and ideal types are idea-constructs that help put the chaos of the social world in order (Weber, 1949 reported in Bruun, 2012). In this chapter, two ideal types are proposed; one for students and one for lecturers. These were formed by describing and interpreting the characteristics of the activity systems found in the data to stress elements common across most cases rather than corresponding to all of the characteristics of any one particular case.

Weber stresses, we cannot claim validity for an ideal type in terms of how well it reproduces or corresponds with social reality; rather we have to look to the resonance of ideal types with lived experience and the insights they provide about what is 'possible and adequate'(Weber, 1970: P323 cited inBruun, 2012). Hence it is not my intention that these ideal types can simply be read into the social world. Rather, it is a metaphorical and not a literal relation; by comparing them to the social world they allow insight into often complex, fluid and sometimes fragmented social phenomena and events. Indeed, this is the only way they make sense, as a tool for viewing the social world, comparing cases and thereby acting as a bridge between generalising and recognising uniqueness in social inquiry (Crotty, 1998).

Based on these details of the ideal activity systems, it can be acknowledged that there are two activity systems, one for the lecturers and the other for the students. These systems have similar mediating artefacts (PRS) but are generally different in terms of components. These activity systems represent the ideal usage for PRS based on the literature review and the data from the participants. Comparing the use of PRS at KKU using the data with the ideal use of PRS from the activity systems will provide a better opportunity to identify its weakness and strengths.

Future studies could consider the gap in knowledge with an aim to further improve the implementation of PRS in an educational setting, with an emphasis on the student-lecturer relationship.

3. The ideal type of students' PRS activity

The ideal activity system for the students shows how students performed the activity, taking into consideration the roles, rules, relationship with the community (students–lecturer) and the objectives, which are different from the ideal lecturers' activity system and, more importantly, not all the students usually consider these components. However, the data corresponds in many aspects to the ideal PRS activity for students. The ideal type approach involves case contrasting and confrontation in an attempt to engage in a systematic development of the ideal activity for students. Therefore, this corresponds to the general view of the data as most of the participants identified similarities and differences across the data to develop the ideal activity. Since the ideal PRS activity for the student shows the ideal use of PRS from the students' point of view, this study focused more on the constraints in the actual use of PRS within the student population. Therefore, this comparison will mainly look at constraints to illustrate the differences. The following diagram (Figure 25) shows the ideal use of PRS for students.

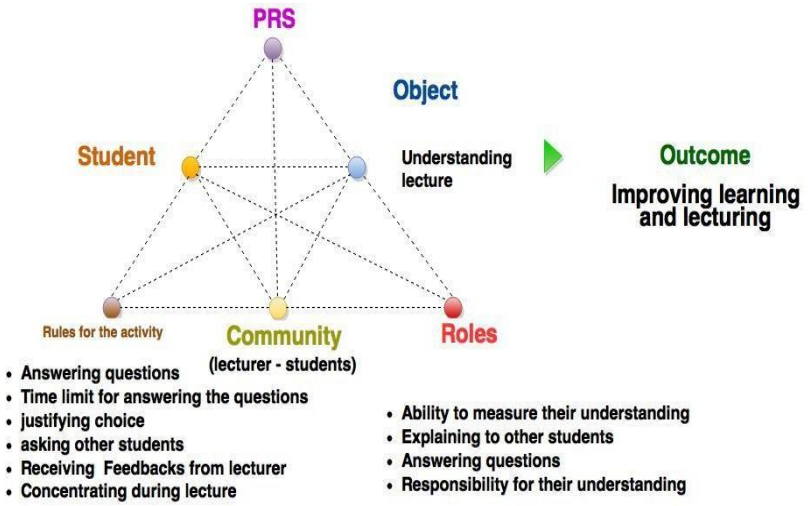

Figure 26 The ideal PRS activity for students

The data shows good evidence for the improvement of the relationship between students and the community by allowing transformation of the objectives to outcomes. However, these relationships are affected by motivation or the way participants see the activity. In other words, the rules generate motivation for the students to engage in the learning process. Unsuitable rules will be a discouragement for the students as the rules in both activity systems overlap. The relationship between students and the community should be positive in order to reach the objectives, but in the current real-world use of the system sometimes constraints happen. For example, some students were not cooperating because they were not motivated to get involved in the activity. Students relationships with the lecturer were mostly based on an ideal relationship from the ideal system. However, this relationship was affected by not applying some rules, for example, not offering feedback or asking unclear questions, as reported by 12 students. Using the traditional methods by not offering feedback may have a negative impact on the learning process as it does not provide any scope for students to react quickly to improve their learning (Kennedy & Cutts, 2005). Immediate feedback increases knowledge retention, prevents repetition of errors and increases confidence more than having delayed feedback (Dihoff *et al.*, 2004).

Therefore, the relationship between the students and community is mediated by the rules of the activity.

Providing and asking clear and accurate questions to measure understanding at different points helps the students to communicate with the lecturer and other students (Eastman, 2007). According to AT, learning is a social activity which occurs through interaction and communication on a social basis with other individuals (Vygotsky, 1978b). However, the findings indicate that in some cases the students were not able to understand the questions sufficiently to ask the lecturer or other students about them. As reported in past research, the difficulty encountered here may be linked to difficult English terms or sufficiently unclear phrasing that even students with a high language proficiency may still struggle (Rodriguez & Shepard, 2013). Therefore, students in the current study faced some difficulties in answering questions in the activity. Moreover, concerns were also raised by some students that the time limit sometimes did not allow them to get involved in the activity. However, other students reported that they got distracted instead as they found that the time limit is more than it should have been. Therefore, it could be argued that the time limit should be sufficient to allow students to answer the questions and also get involved in the activity.

Discussion is an important aspect of the PRS activity as it allows students to justify their answers or ask other students for help, as reported in the data. It has been previously documented that lecturers need to adopt this approach with PRS to improve learning (Yoder & Hochevar, 2005). There have been many recommendations in previous studies to promote engagement and interaction in the classroom when using the PRS and offering discussion opportunities (Agbatogun, 2013; Reay *et al.*, 2005). This was also reported in this study where

some students acknowledged that an opportunity to engage in discussion allowed and encouraged them to approach other students for more clarification. It is important to note that based on the findings, discussion was not possible in some cases as students were not able communicate with other students to reach their objectives. The main reason given was that the lecturer did not offer enough time for discussion. This could effect students' ability to receive feedback from the lecturer, or ask them questions, which is a major issue as it may obstruct the application of the rules for the activity, similar to a traditional lecture format where there is limited interaction between the lecturer and the learner (Eastman, 2007). Technical problems have also been reported, occurring several times during the term; this issue was also flagged up in past research as it can distract students (Martyn, 2007).

The relationship between students and the community can also be affected by not applying the rules and this can lead to not achieving the objective of the activity. Constraints in the relationship between students and their community will not allow the members of the activity to fulfil their roles, as showed in the ideal activity system. Based on the ideal activity system the students should be able to play different roles in the activity, as discussed earlier in this chapter. When PRS was applied in this study, students were not able to play a variety of roles at all times. The lack of technology skills is another barrier to integrate technology that allows effective teaching to take place encountered in this study (Alfahad, 2012).

Furthermore, some students did not fulfil their roles as they were not motivated to participate or get involved in the learning activities with PRS. Instead, they preferred listening to the lecturer's explanations and this issue will be discussed later in this chapter. Thus, it can be suggested that it is quite difficult for students

to measure their understanding if they do not engage in their own learning process. As reported in the past literature, learning is not only about using pre-existing knowledge but also involves the ability to interpret a problem embedded in social interactions (Edwards, 2007). The difficulty to grasp the clarity of the questions did not allow students to answer these questions as they should. The rules or strategies of answering the questions may affect the students' roles in the activity, to achieve their objectives as well as their ability to express their understanding. This refers to transmissive learning, whereby some students are influenced by the old style of learning and are resistant to the change to constructivist learning. PRS is about learning through interaction with lecturers and other students in order to construct learning as an active process and not act as a passive learner by just relying on the lecturer. From an educational perspective, learning occurs when there is a dialogue or interaction between student, the instructor and the educational environment (Agbatogun, 2013). The findings from the majority of the students in this study support the above statement. In the traditional learning environment, this dialogue or interaction is absent, as in the traditional learning environment the transmissive method was commonly used for learning purposes (Kennedy & Cutts, 2005; Simpson & Oliver, 2007).

From social constructivist perspectives, knowledge is usually gained and maintained through social interaction and collaborative learning (McDonald and Gibson, 1998). Huang (2002) further elaborated on this idea and explained that learning best takes place when experienced individuals are given the opportunity to help inexperienced learners through what is commonly known as collaborative learning; the learner and their roles are an important element in this study. Hence it can be argued that learning does not occur in isolation from others and perhaps

the usefulness of PRS is further emphasised here as a technological approach which provides a strong platform for teacher-learner, as well as learner-learner interactions to take place in an attempt to benefit from an effective learning process. Nevertheless, this area should be further probed in future research given that some students also perceived the use of PRS as an obstacle to learning in the form of a dialogue with others.

Overall, as discussed above, there are several constraints involved in the implementation of the PRS activity for students in the educational context. These challenges tend to have a negative impact on every component of the activity, hence also effecting the relationship between the components of the activity system themselves. This shows how the components of the student activity system are strongly linked to each other and allow transformation in the objectives.

4. The ideal PRS activity for lecturers

The formation of the ideal activity was based on characteristics of the theme related to the study. Different explanations are provided in this chapter with an aim to give more context and justification for each ideal activity. In this study, the activity for lecturers is motivated by an intention to get students to understand the content deeply. This is the objective for the PRS activity from the lecturer's perspective, and that is one of the main differences between lecturers' and students' activities. From the data, 8 lecturers reported that their objective is about helping students to understand the content by using the PRS. According to SMAR, model technology can be effective when it can successfully achieve the objectives of the educational activity for the lecturer and overcome difficulties in implementation (Puentedura, 2010). It has been argued that the PRS can be a solution promoting effective teaching to achieve the objectives for lecturers in

comparison with a traditional lecture (D'Inverno, Davis & White, 2003). Regardless of the way in which this technology is used to achieve these objectives, all lecturers agreed on this objective, which helps students to develop their learning and understand. The above findings help to provide a good insight into lecturers' perceptions of an effective learning approach in the classroom. Below is figure 26, which illustrates the ideal lecturer's PRS activity.

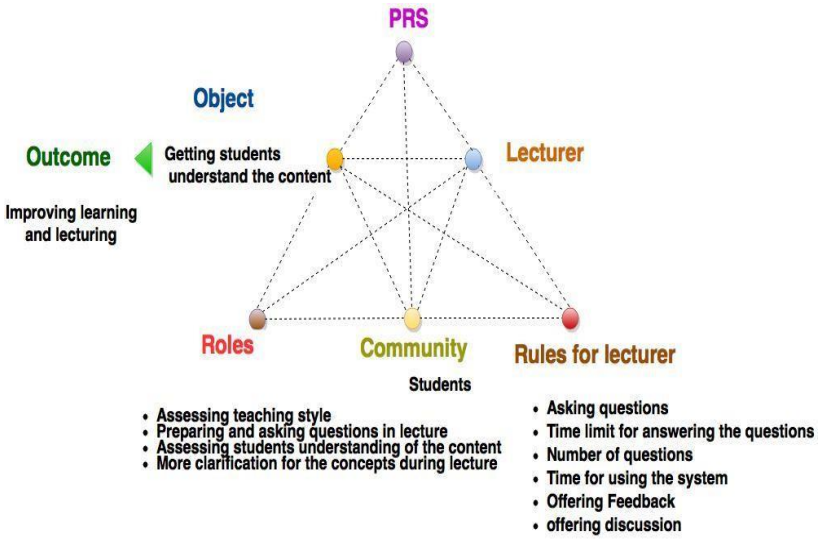

Figure 27: The idealised summary of PRS activity for lecturers

Based on the above diagram it could be suggested that there are many differences between the students' and lecturers' activity which are not only restricted to the objective. The rules in this activity help mediate the relationship between the lecturer and the students. Currently, there is more emphasis on learner-centred learning than instructor-centred learning; this has changed the pedagogical approach to ensure that there is more involvement of the learner with the lecturer in the learning process (Milrad, 2003). However, these rules offer the lecturer more control over the activity than the students. Both the lecturer and the students participate in the activity, but it tends to be the lecturer who selects the time for using the system and also the number of questions.

On the other hand, students answer questions and can show their preferences by using the PRS questions. This is an interesting finding, given that previous research found that students prefer to wait to hear the answer from the lecturer in fear of giving wrong answers (Kennedy & Cutts, 2005). The lecturer must ask questions during the lecture using PRS, which is a rule in PRS activity that was not required or optional in the traditional lecture, as reported by 5 lecturers. Moreover, the activity is not about asking questions, but needs new rules to be applied to enable the activity to run effectively as a new, alternative strategy to the traditional lecture. This is in line with Trees and Jackson (2007) who reported that PRS indeed provides an alternative approach to the traditional method, where students raise their hand to answer. The time limit for asking each question should be suitable to allow students to think about the answer, translate difficult English terms or even seek help from other students if needed. Both students and lecturers see this rule as important for them to benefit from using PRS. As such, the above findings indicate that the student-lecturer relationship is positively influenced by the use of PRS in the classroom. Also, after reviewing the literature in this area no clear recommendations were provided about the time limit for PRS questions. However, this might be a personal preference where every lecturer estimates the time limit for each question.

In order to increase interaction and communication the suggested number of questions in the PRS activity is between two and three questions (Eastman, 2007). Agbatogun (2013) suggested that the instructor should ask three questions during the lesson with different difficulty levels and Martyn (2007) also recommended choosing a suitable number of questions while considering time and content. However, in this study, the clarity and difficulty of the questions were constrained in the PRS activity. On one hand, 6 lecturers preferred to use 3 to 5

questions, with the possibility of adding more questions to enhance clarification. On the other, 2 lecturers reported that the total number of questions should not exceed 3 questions. Therefore, as far as the number of questions that should be asked in a lecture is concerned, the current study does not seem to support past research given that the participants had different preferences.

According to DeBourgh (2008), the percentage of the responses can be an indicator of the quality of the questions. Although the lecturers felt that their questions were clear, and the students would be able to answer them, some students reported that some questions were difficult or unclear (13 students, in the group interview). Therefore, although the rules were obvious for the lecturer there were still preferences or different points of view regarding the type of questions asked. The majority of lecturers were using multiple choice questions. However, Eastman (2007) emphasised that questions should not be limited to only one style. There should be variety of questions to make the activity more interesting and increase student attention. This is an important finding which contributes to past literature, confirming an increase in students' attention when PRS is used in the classroom (Bruff, 2007; Simpson & Oliver, 2007); (Roush and Song, 2011). The majority of the participants reported that using PRS during the lecture was a motivation to improve the relationship between the lecturer and their students (7 lecturers and 16 students, from the group interview). Although 2 lecturers and 4 students preferred PRS to be used at the end of lecture, the data shows that using PRS at the end limits the relationship between the lecturer and students.

Displaying results and offering feedback is an important rule for PRS activity, according to 9 lecturers and 19 students. These features were not available in

the traditional lecture as the lecturer was not able to ask questions when PRS was used, or even show the answers. Seven students reported that lecturers sometimes did not offer feedback for all the questions, or even commented on wrong answers, which limited the benefits of the PRS. This finding contradicts previous evidence pointing towards the use of PRS in the classroom to pave the way for immediate and accurate feedback (Bruff, 2007). Additionally, because of constraints in the lecture caused by time, amount of content or technical problems, the lecturer did not offer enough time for discussion (12 students reported that). These technical issues waste lecture time as the lecturer must spend time solving them instead of delivering the content of the lecture (Beatty *et al.*, 2006). Therefore, it could be argued that not offering enough time for discussion could have a negative impact on the relationship between students and lecturers, or between the students themselves and their objectives. In fact, it has been previously documented that allowing discussion time between the learners before or after showing the answer for a question allowed them to share knowledge (Martyn, 2007).

Constraints in relation to the rules of the lecturer's activity can prevent the lecturer from fulfilling his roles. The lecturers' roles include assessing teaching style and giving feedback, which was not possible in the traditional lecture. In the traditional lecture, lecturers were not able to assess their teaching style because the traditional format was based on short quizzes, where the lecturer took time to reveal the results. Based on previous studies, it could be suggested that PRS can be used as a form of formative and summative assessment to examine students about the content (Agbatogun, 2013).

PRS has offered fast and accurate results for assessing their teaching style based on the students' answers (7 lecturers). Alfahad (2012) reiterated this idea by emphasising that PRS has indeed changed the role of the lecturer from lecturing only to other, different roles. Furthermore, this feature can be used to offer a new role for lecturers to assess students' understanding and offer more clarification if needed, based on the students' answers. This finding is also supported by Zhu (2007). All of these are new roles for the lecturer when introducing the PRS and applying the rules of the activity. These roles cannot be implemented without planning, preparing and asking questions in a suitable time period. Therefore, the rules and roles of the lecturer in the PRS activity have evolved following the introduction of PRS to achieve the objectives, which is helping students to understand the content. The chance for the lecturer of transforming the objective to an outcome of the PRS activity is high when the rules are applied properly, and the roles are fulfilled. However, there are many constraints which impede this transformation; for example, technical problems, not applying rules and maintaining the varying roles of a lecturer. Moreover, any issues in the students' activity system can, in turn, effect the lecturer's activity system.

Based on all the above, it can be concluded that there are two activity systems for students and lecturers with different objectives, rules and roles. These activity systems overlap with each other; in other words, they work together if there are any constraints in any relationship that will effect either system. The transformation of objective to outcome occurs through interaction between the two activity systems.

5. The ideal PRS activity for constructivist learning

Learning was defined by many researchers as a connection or dialogue between learners and instructors and the content of a lesson, which leads students to learn effectively (Agbatogun, 2013; Draper, Cargill & Cutts, 2002; McCabe & Lucas, 2003). Constructivist methods involving interaction between lecturers and learners mostly leads to an improvement in the learning process. Many studies refer to limited interaction between learners and lecturers in the traditional lecture, and between learners themselves (Sharples, 2000). For the lecturers to have effective teaching methods, they need to make learning a social interaction involving a dialogue between lecturers and learners to achieve the objectives of the learning outcome (Agbatogun, 2013). With a lack of interaction, the learning process does not provide an opportunity for effective learning to take place for the learner as they do not have a chance to engage in critical thinking or use cognitive processes necessary to make the most out of this learning process (Robinson & King, 2009). The data in this study showed that there was a preference for using PRS during the lectures. This preference is embedded in constructivist learning, which PRS also offers.

In order to change the passive role of the learner in the traditional learning environment the instructor needs to shift to a more interactive method, where the learner is more involved in their own learning during class time (Kennedy & Cutts, 2005). Additionally, to promote interaction the instructor needs to adopt an approach which involves peer discussion, practical exercises and demonstrations

(Yoder & Hochevar, 2005). The diagram below shows how PRS works to support constructivist learning from the lecturers' perspective.

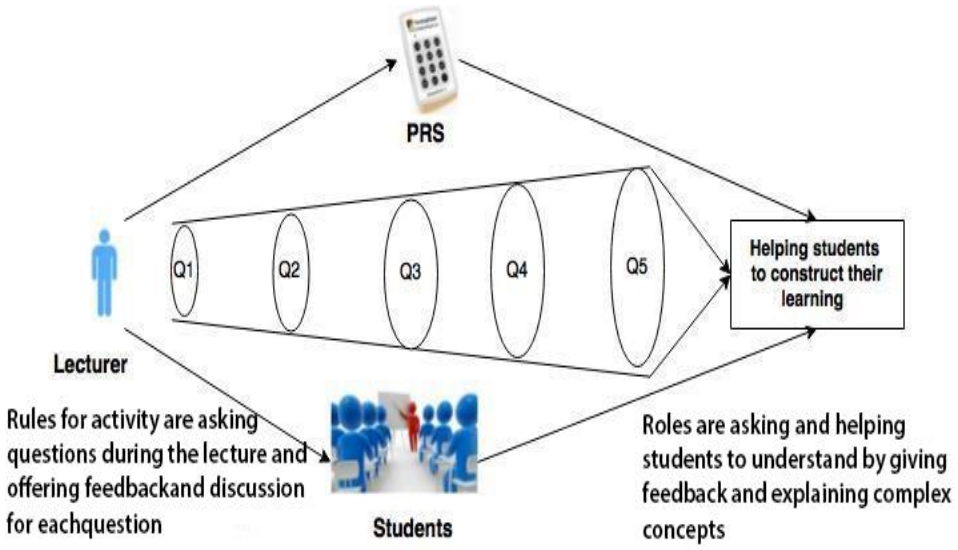

Figure 28 How PRS works to support constructivist learning from the lecturers' perspective

One of the rules of the PRS activity is the lecturer asking questions of all the students. Seven lecturers described this form of learning as constructing students' understanding. This process can be done by asking several questions in the lecture to cover the most important points. The rules are similar to the lecturers' PRS activity model in terms of asking questions, the quality of the questions, and also the time limit for answering these questions, as well as other rules. Additionally, the roles will be the same as the basic ideal PRS activity; however, the lecturer should select the number of the questions. This decision will be based on the importance and distribution of the questions. The purpose of the questions in this form of learning is to stimulate interaction between students and with the lecturer. Similarly, Meedzan and Fisher (2009) found that introducing PRS can provide an opportunity for more interaction in the educational environment between students and lecturers regardless of the number of students in the class. Moreover, PRS can also be a solution for creating an effective teaching and learning environment to increase interaction in the classroom (D'Inverno, Davis &

White, 2003). Moreover, asking questions could help students to further develop their understanding of the content. Diagram 27 shows how the PRS works to support constructivist learning from the students' perspective.

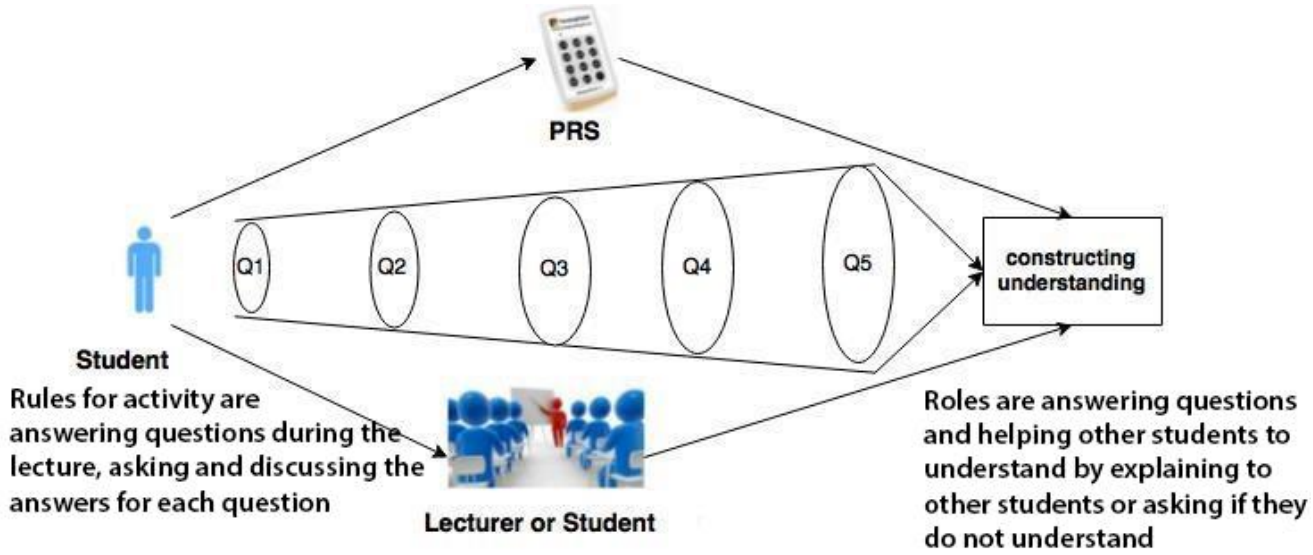

Figure 29 How PRS works to support constructivist learning from the students' perspective

In addition, the students explained that receiving questions helped them to concentrate and remain active (16 students reported that). Past studies also found that immediate feedback increases knowledge retention, prevents repetition of errors and increases confidence (Dihoff *et al.*, 2004). The discussion in lecture is a vital phase in the PRS activity for the constructions of students' learning (Martyn, 2007). Moreover, one of the advantages of using PRS in this form of learning is that the majority of students may have more chances to understand every concept before they move to a new concept in a lecture, or they might receive more clarification if they did not understand, as reported by some students. Students who answer a question correctly are more likely to also answer the next question correctly (Reay *et al.*, 2005) and the above finding seems to be in line with this.

The data also showed that lecturers can cause some difficulties for learners

during the activity when the activity is implemented without properly applying the rules. Preparing for PRS activity in an effective way can help students perform and learn successfully, or they risk being distracted by the unsuitable use of PRS (Beatty *et al.*, 2006). The objective of the activity for the lecturer is helping students to understand the content by using PRS and applying the rules. One of the important rules is asking questions at the right time. It has been reported by 6 students that the lecturers sometimes ask questions before they have a chance to understand a concept. Essentially, asking a reasonable number of questions at the right time can help students to get involved in the learning activity and better understand the content (Martyn, 2007). Moreover, the quality and clarity of the questions are important to guide the students' learning process, based on asking several questions (Beekes, 2006; Draper, Cargill & Cutts, 2002). However, the findings showed that the quality or clarity of the questions were not considered by the lecturer in many occasions to achieve their objectives in this activity, given that many students got confused or distracted and were not able to proceed to the next question (7 students reported that).

As previously discussed in this chapter, the adequate if not ideal, number of questions which should be asked during a lecture is not clear-cut. Nevertheless, it could be suggested that the focus should remain on the fact that throughout this process students should achieve their objectives by constructing their understanding. This construction occurs via a transition from one concept to another with the help of questions and discussion. The discussion allows interaction and promotes thinking about new concepts to eventually link them to the topic of the lecture. The lecturer, when using PRS, will be able to achieve objectives by helping students to construct their learning, who are in turn in a better position to increase their understanding of the subject matter while

addressing each question, one at a time.

6. The ideal PRS activity for transmissive learning

In the PRS activity there was a preference for using the PRS at the end of the lecture. During a traditional lecture, the lecturer delivers information and students act as a receiver for the information from the lecturer's explanation. When the student acts as a listener, they learn some of the information, or in some cases none of it. Learners have previously reported transmissive learning as being not very effective in improving their learning (Crouch & Mazur, 2001).

Using PRS for the purpose of transmissive learning has also been observed in the current study. Lecturers justified their opinion on the use of transmissive learning by saying that the time limit for each lecture and the content to be delivered only makes space for three questions at the end. Those lecturers described this form of learning more elaborately by reporting the following: "*we can teach a normal lecture by explaining the concepts and at the end of the lecture we can measure the students' ability to memorize the information*". Figure 28 shows transmissive learning with PRS from the lecturers' perspective:

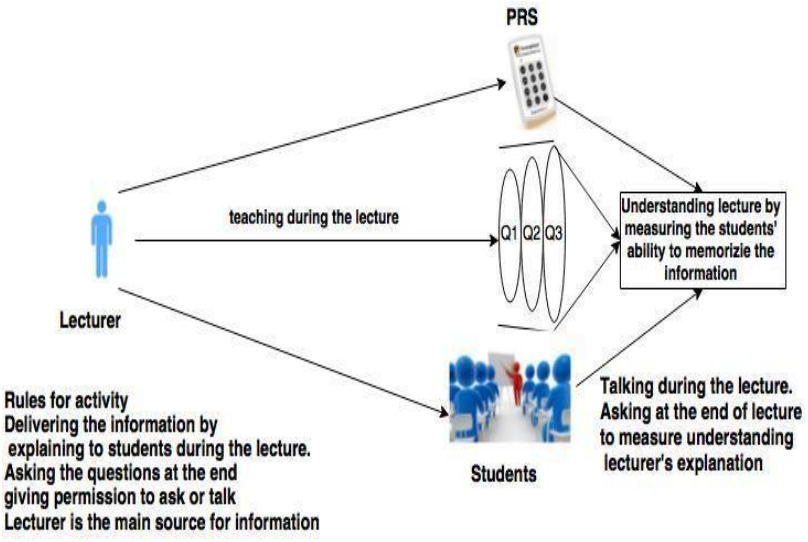

Figure 23 Transmissive learning from the lecturers' perspective

It can be seen from the above diagram that the lecturers' objective is delivering the information and making sure the students were able to memorize it, which is a sign of a good understanding of the content in their opinion. According to the SAMR model, this level of learning enhances the method of asking questions and does not encourage a high level of learning (Puentedura, 2010). This objective has changed some rules of the ideal PRS activity. For example, a lecturer is active during the lecture by talking and this is relatively similar to the traditional lecture (transmissive learning). In this form of PRS use, students usually do not have an active role during the lecture time and it is often a situation of one-way information transfer. Educational theorists argue that the transmissive approach does not foster learning as they believe that learning is mostly "an intentional, active, conscious, constructivist practice that includes reciprocal intention-action-reflection activities" (Jonassen & Land, 2012). This ultimately leads to a lack in interaction between students and their lecturers and between the students themselves (Sharples, 2000). The role for the students is often limited as a result of using this form of learning, whereas using PRS as a constructivist learning strategy has made both the students and their lecturer more active during the lecture.

Additionally, it is often considered that the lecturer is the main source of information, given that they talk during the lecture and the students act as listeners. Transmissive learning has been defined as a one-way mechanism of transferring knowledge. Therefore, this rule limits interaction between students in the classroom and gives them only one option, which is asking the lecturer questions at the end of lecture, if there is time to do so. Surprisingly, one rule underlying this form of learning is that students are not allowed to talk or ask questions during the lecture unless the lecturer gives permission. This form of

learning does not allow students to interact with each other. Figure 28 shows many similarities to the traditional lecture (transmissive learning). The rules in this form of activity generated some constraints between the lecturer and their students, limiting the possibility for interaction between students and lecturers. Therefore, the roles for the participants in this activity appeared to be the same roles as the participants in the traditional lecture. These constraints have reduced the possibility for the lecturer to transfer an objective to an outcome as expected, by understanding instead of simply memorising the content.

This form of activity has not changed the way the students act or perform in the traditional lecture. They generally behave as passive learners during the lecture, asking permission to get involved in the learning activity as otherwise they need to sit and listen to the lecturer's explanation and take notes. The following diagram shows the students' perspective of using PRS as transmissive learning form:

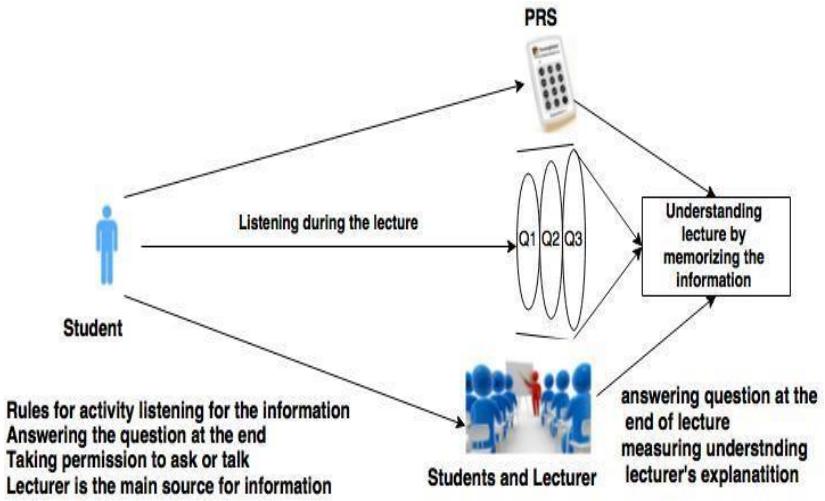

Figure 30 shows the students' perspective of using PRS as transmissive learning form

The diagram above shows how the students generally act in this form of lecture when using PRS at the end, and this is the ideal activity model of transmissive

learning for students. Generally, this is different from what has been reported in the literature review with regard to the positive impact of PRS on students' learning. It has been reported that PRS provides alternative pedagogical strategies (Kaleta & Joosten, 2007). Some studies indicate that PRS, when used as a teaching strategy, effectively engages students to participate and motivate them to learn throughout the learning process (DeBourgh, 2008; Moredich & Moore, 2007; Stein, Challman & Brueckner, 2006). However, in the current study these findings do not support the past research, bearing in mind that although PRS has been used and incorporated in the lecture, transmissive learning still took place. Hence, the benefits of PRS were not observed as expected based on past research.

Using PRS at the end of lecture for two or three questions may not make a massive change unless the activity provides more interaction with individuals and within the environment during the lecture, while also using other teaching styles. The main rule for the activity is listening to the lecturer's explanation during the lecture, but this does not necessarily promote relationships or an interaction between the individuals in the activity. Moreover, it was reported that the majority of the students had difficulty in their English languages skills (16 students reported that). Therefore, it can be anticipated that they will not be able to achieve their objectives as the rules do not allow them to talk or ask questions during the lecture. They are only allowed to talk and ask questions at the end of the lecture and only with the lecturer's permission, if there is enough time (7 students reported that).

The rules of the activity mean the lecturer is the most trusted source of information, according to four students. Therefore, the relationships between students will not

be supported by these rules or forms of using PRS. These roles will not help students to transform their objectives to outcomes as they only act as receivers for the information; it can be suggested that this may limit their ability to concentrate and memorize new concepts. The students' roles, when using PRS at the end, are about measuring their ability to memorize the information based on the lecturers' explanation. This shows that the students will not spend time thinking and will only rely on the facts provided by the lecturer during class time. There are also many possibilities for students to get distracted as they only act as a passive listeners during the lecture, which perhaps makes it difficult to concentrate or pay attention throughout the lecture. Compared to using PRS during the lecture, there is always the possibility of discussion and improving concentration. Therefore, there is no advantage of using PRS at the end of lecture over using it during the lecture.

7. General implications of using PRS on students' learning process

7.1. Participation

Many studies found that using PRS helps students to be active during the learning process, in contrast to the traditional lecture where students are normally passive learners (Caldwell, 2007; Draper, Cargill & Cutts, 2002; Martyn, 2007). Past research also reported that the interactivity pattern of using PRS increased students' participation in the educational environment, leading to an improvement in their academic achievement (Blood & Neel, 2008). In this study, 20 students from the group interview agreed that they are more able to participate with PRS. Additionally, as reported in the questionnaire, 97% of the participants report that they are more likely to participate with PRS.

This high percentage in favour of the use of PRS is considerable evidence supporting the effectiveness of using PRS to increase participation. The lecturers also agreed with the students that PRS has indeed increased opportunities to participate. Similarly, past literature studies have also shown that PRS has the potential to increase student participation (Caldwell, 2007; Draper & Brown, 2004; Fan & van den, 2006; Reay *et al.*, 2005). Although the findings support existing empirical evidence in this research area, the challenges of using PRS have not yet been in the limelight of current literature. In some cases, PRS might not help to increase participation. These challenges include not applying the rules for the activity and having technical problems during the activity.

7.2. The anonymity of answers

Answering anonymously is an effective feature for encouraging the students to participate and get involved in learning; 17 students agreed with this in the group interview, as did 88% of participants who filled in the questionnaire. Indeed, it has been previously reported that one of the main reasons for not participating in the traditional classroom is the anxiety of making mistakes or giving wrong answers (Beekes, 2006). The students felt less stressed when they answered PRS questions anonymously. This technology allows students to answer the questions and engage in learning without the fear of making mistakes.

On the other hand, 2 students preferred to be identified when using PRS as they felt it is rewarding for them when they choose the right answer. In general, students would respond more when they aware of the anonymity of their answers when using PRS, in comparison with the traditional lecture; however, it can also be rewarding for the students who choose the right answer to be identified in front of other students (Shneiderman *et al.*, 1995). Therefore, using PRS anonymously

is effective in increasing students' involvement in the learning process. However, it might be useful to identify the students who choose the right answers throughout the lecture as a reward for them. The affordance of PRS allows lecturers to record the students' responses, which allow them to also identify who chooses the right answer. This feature is one of the main advantages of using PRS as shown in this study as well as past research.

7.3. Attention or engagement

At the beginning of any learning process, students need to be engaged (i.e., by warming them up for the learning process) by asking them some questions about the topic of the lecture (Agbatogun, 2013). Using PRS to ask questions at the beginning can encourage students to be ready for the lecture much faster compared to the traditional lecture, while also encouraging them to pay attention during the lecture (Simpson & Oliver, 2007). The affordance of PRS, as previously noted, allows the lecturer to get students engaged in the learning process. The findings in the group interview show that using PRS has increased their attention during the lecture (14 students reported this). While using PRS the students were encouraged to pay attention to be able to answer the questions.

Five students reported that PRS did not help them to concentrate, though PRS is an easy tool to use for teaching and learning purposes. It has been previously reported that technical problems seem to be the most challenging issue experienced when using PRS, having an impact on students' attitudes toward this technology and causing a lot of potential distraction for them (Draper, Cargill & Cutts, 2002). Nevertheless, Roush and Song (2011) provided supporting evidence in favour of using PRS to increase students' attention. Therefore, overall

and despite the aforementioned difficulties, it could be concluded that PRS was a successful tool to increase students' attention in the current study.

7.4. Interaction

Introducing PRS provides a good opportunity for more interaction in the educational environment between students and lecturers, regardless of the number of students in the class (Meedzan & Fisher, 2009; Sharma *et al.*, 2005). The findings in this study also show that PRS encourage students (14 students reported this) to interact with other students through asking or answering questions. Additionally, seven lecturers agreed with the idea that students are more able to ask questions to lecturers in PRS based lectures compared to traditional lectures and also with more opportunities to discuss answers with other students. This discussion is important as it can help students to contribute to the learning process and also discuss difficulties they may have in their learning in order to improve (Kennedy & Cutts, 2005). In the traditional learning environment, this dialogue or interaction is absent as the transmission method is most commonly used for learning (Kennedy & Cutts, 2005; Simpson & Oliver, 2007).

Introducing constructivist methods through using PRS involving interaction between instructors and learners mostly leads to an improvement in the learning process. It can be argued that PRS can be a solution for creating an effective teaching and learning setting in order to increase interaction between the learners, as well as between students and the lecturer (Caldwell, 2007; D'Inverno, Davis & White, 2003; Draper, Cargill & Cutts, 2002; Martyn, 2007). To conclude, this approach of using PRS allows students to increase their understanding through interaction and hence promote learning from other individuals.

7.5. Understanding

Students' understanding can be facilitated by using PRS in learning activities in order to promote critical thinking (Reay *et al.*, 2005). From the findings, understanding has been described by 6 students as understanding the meaning of English terms through their ability to ask and answer PRS questions. Moreover, most students (17 students) defined understanding as comprehending concepts one by one over the course of one lecture and making connections between them. Havill (2007) reported that PRS technology is effective where students use keypads to answer the PRS questions, and Beatty (2004) sees that as a process for developing a deeper understanding given that students need to decide on the most suitable answer for each question, which encourages them to think critically about the concepts. Stuart, Brown and Draper (2004), as well as Mayer et al. (2009), claimed that PRS questions encourage students to think and learn throughout this process.

Improvement was reported by many students (16 students), who explained that within the PRS activity they are more able to make comparisons, apply concepts, analyse information and assess the value of it. Past literature found that the questions and the ability to interact with other students and the lecturer allowed students to improve their learning (Mayer *et al.*, 2009). Interestingly, and in support with the above statement, the current study found that around 83% of participants reported that explaining concepts to peers helped them to increase their understanding of complex material. Additionally, 75% of the students believed that justifying their choice of the correct answer helped to increase understanding for the other students and subsequently improve the learning process. This improvement promotes a high level of learning, as reported by a few students. For example, the ability to make comparisons, apply concepts,

analyse and evaluate. Although this is an indication of any improvement in the learning process it cannot be generalised to all the students.

It can be concluded that an overall improvement in the learning process has changed the learning experience of the students, as reported in the quantitative data. Generally, over 85% of students reported that their learning experience has improved. This is an indication of an improvement in the learning experience of both the students and the lecturers, similar to what previous research also found (Crews *et al.*, 2011; Zhu, 2007). Compared to learning in the traditional lecture the students have a more positive experience when using PRS in the classroom.

7.6. Feedback

Based on the group interview, twenty students reported that they received feedback if they did not understand or chose the wrong answer. In the questionnaire, 100% of participants agreed that they had immediate feedback and that helped them to understand the content. Students have long been reported to be able to measure their understating and obtain more clarification from other students or the instructor (Draper & Brown, 2004; Kennedy & Cutts, 2005). Furthermore, PRS can be used as a form of formative and summative assessment to examine students about the content and offer them instant feedback (Agbatogun, 2013).

In line with past research, the students were in a better position to receive faster feedback when introducing PRS to the classroom as it offers immediate and accurate feedback (Bruff, 2007). Further support was found in relation to the histogram, which shows the percentages of the answers for the students, helping the instructor to identify the weaknesses and strengths of the students as learners (Draper & Brown, 2004; Russell, 2008; Simpson & Oliver, 2007).

7.7. Confidence

Confidence is an important factor for students in their learning process. The process of using PRS is also about helping students to increase their confidence about their learning by showing their answers and providing feedback anonymously (Mayer *et al.*, 2009; Russell, 2008). In the group interview, 11 students felt more confident about getting involved in the learning process with PRS compared with the traditional lecture format. This finding was also supported by 3 lecturers who noticed that the students' confidence increased with the introduction of PRS.

In addition to that, 7 students perceived the discussion after each question as helping them to increase their confidence in the learning process and allowing them to interact with other individuals. Indeed, having peer discussion before or after showing the results can give students the opportunity to be more confident about achieving more correct answers (Kennedy & Cutts, 2005). Furthermore, 17 students in the group interview reported that PRS also helped to reduce fear of making mistakes as they would not be identified. These findings find support from past literature where PRS has also been found to increase students' confidence and limit their fear of making mistakes (Beekes, 2006; Kennedy & Cutts, 2005)

7.8. English language skills

PRS is an effective strategy for students to learn in English in the classroom and to enrich their understanding of new terminologies (Agbatogun, 2014). They reported that the system has facilitated the communication between the lecturers and students and also helped them to understand many English language terminologies. One lecturer believed that students learned many English terms

with PRS, but they still avoided asking or answering questions because their ability to communicate did not improve enough. For students with an intermediate level of English language skill, using PRS has previously been found to be useful for students; however, students at a lower level might not necessarily benefit from the use of PRS as some terms are still difficult for them to grasp (Rodriguez & Shepard, 2013).

Challenges encountered in relation to improving English language skills are mostly relating to not applying the rules appropriately. The majority of students (14 students) reported that they were not offered enough time during the activity and this did not help them to learn new English terms. PRS can be a vital factor to help students to improve their understanding and this is mainly facilitated when allowing interaction between students. This improvement varied from understanding the meaning of and learning new terms to an ability to interact in English as a second language.

7.9. Motivation

In many studies findings showed that using PRS for learning does increase students' attendance, especially if this usage is linked to marks (Jackson & Trees, 2003; Mayer *et al.*, 2009; Thornton, 2011; Wit, 2003). Similarly, in this study, PRS has encouraged some students (13 students) to attend and participate in the lectures. Using PRS has also helped the lecturers (7 lecturers reported that) to increase attendance in their lectures. These findings point to PRS as a motivational tool to increase attendance. The motivation mainly underlies an attempt to increase participation and interaction for the students during the learning process, as reported throughout this chapter. However, past research has shown that giving marks for answering questions using PRS increases

students' attendance significantly, as this proves to be a motivation for them (Burnstein & Lederman, 2001). In this study, although the lecturers did not assign any marks for using PRS, in some subjects they were assigned marks for attending or participating in the traditional lectures, which seemed to have encouraged some students to attend.

Additionally, 15 students described the PRS activity as fun and enjoyable. 3 lecturers also reported that the students enjoyed using PRS. The use of PRS as a motivational tool was noted by students, who enjoyed learning while using it. In previous studies, PRS was also found to be fun for the students and they enjoyed learning with it (Meedzan & Fisher, 2009; Trees & Jackson, 2007). This is completely different from feelings reported during the traditional lecture as the students felt bored when they only acted as listeners for the lecturer. Moreover, 97% of the students felt that obtaining the right answers helped them feel more motivated to participate.

Other students (5 students) thought that PRS motivated them when they saw other students being active and participating in the lectures and they felt encouraged to do the same. The general pattern of the learning process was an increase in motivation for the students. In other words, seeing other students becoming involved in the learning process was a significant motivating factor for other students to participate. Nevertheless, it should also be noted that some students might have been affected by their previous experience of the traditional lecture, which made them anxious about participating. Furthermore, 4% of the students did not feel that they were encouraged to learn from other students. This might be the result of the system being quite new for them and they might have had some problems in getting accustomed to it.

8. Conclusion

The discussion chapter has explored the findings of the current study in relation to previous studies, as identified in the literature review. The researcher generated frameworks based on AT and also used an ideal type of the activities to make sense of the findings and make them clearer. The frameworks represent the whole activity and were built based on the third generation of AT. Overall they consist of two activity systems; one for the students and one for the lecturers. The similarities and differences across the aforementioned systems were discussed in this chapter. Additionally, any overlapping between any activity system was also illustrated in this chapter. Any constraints in each one of them had the potential to affect both activity systems. Conversely, the findings indicated that any effective interaction between the components of the activity systems helped to generate the transformation from the objectives to an outcome through a dynamic learning process. This dynamic learning was explained mainly from two perspectives based on the data from the participants and in line with previous studies in this field. The main approaches to learning are constructivist learning and transmissive learning. The differences between the aforementioned approaches were also illustrated based on AT when using PRS. Therefore, PRS is an effective learning technology providing that it will be used as a constructivist learning strategy and applying the roles and the rules.

In the next chapter, the main findings and contributions of the study will be summarised. Research limitations experienced during the research process will be introduced, along with a set of recommendations for future research.

Chapter 8: Conclusion

1. Conclusion

This study has examined the use of PRS among undergraduate students, while using AT as a lens to analyse the effectiveness of this technology in learning development. The aim of the study was to understand the use of PRS in Higher Education to increase interaction and develop learning. The research questions were as follows:

1) How does PRS influence relationships in the context of an educational environment?

2) How does PRS influence the students' experiences in the educational environment?

3) What are the implications of the PRS activity?

The study was conducted at KKU in Saudi Arabia. The focus of the study was on the use of PRS at the undergraduate level in the Medical School where PRS is used. The process of learning while using PRS was the main concern for researcher. Additionally, the general influences of PRS on students' and lecturers' experiences were investigated.

A qualitative methodology was used to collect rich data from the participants; GT informed the research methods and AT was used to analyse data from the participants and the use of PRS. It was clarified that the reason for choosing GT was because it obtains more data and moves forward and backward during the process to fully explore the situation. The process of collecting and analysing data has been through different phases, starting with distributing the questionnaire to students and interviewing the participants (students and lecturers).

This study contributes to the literature in several ways. One such aspect is understanding the use of PRS in the Saudi context with different approaches for teaching and learning. Specifically, the study looked at whether the use of PRS within a traditional transmissive education environment afforded the adoption of more constructivist and participative approaches to teaching and learning. Moreover, combining GT with AT as a new methodology in the Saudi context allowed the relationships between different elements of the learning environment to be analysed and compared, thereby allowing substantive changes in the nature and focus of participation to be identified. The study concluded with recommendations for HEIs in Saudi Arabia to improve the use of technology for learning development and promote constructivist learning environments. Additionally, the study informs the policy makers of the potential contribution and worthiness of integrating technologies to develop teaching and learning in HEIs in Saudi Arabia.

2. Difficulties in conducting the research

A few difficulties were encountered in this study. The first difficulty was the approach, including methodology and data collection procedures for the study. Combining GT and AT as an approach for collecting and analysing data is a new approach in the Saudi context. A lot of time and effort was dedicated to combining these approaches in a scientific manner. Additionally, this combined approach was explained and justified to the case study university (King Khaled University) and the sponsor of the study (Ministry of Education). After meetings and discussions with them, a 4 months period was proposed in which the researcher could meet the participants and collect the data. This created some constraints due to limited resources. Lecturers were invited to participate in the study, which some were reluctant to do. Additionally, the researcher offered workshops in the

university totalk about educational technology in general, PRS specifically and potential ways of using it. The study was conducted at KKU Medical School; other schools were interested, but because the approval application process to both the sponsor and the university took a long time, adding other departments to the study was incompatible with the research plan.

The data collection was not an easy task due to the lecturers' busy schedule and the difficulty of arranging places to conduct the interviews for both the lecturers and students. Participants' characteristics and motivation were issues, as some lecturers were not motivated to engage in the study or to be interviewed more than once. The reason for this is because they felt the study represented a kind of unwanted assessment of their ability to use a new technology. Therefore, it could be speculated that this limited their ability to generate in-depth. Also, the lecturers required multiple assurances that the study was independent from the university and that their privacy would be protected. In addition, questionnaires could not be distributed to the students at the beginning of the term because of administrative difficulties and since they had little experience of using the system at that time. This was unfortunate as this would have obtained more detailed data from the students and added more depth to the questionnaire. To mediate this, further questions were added to the questionnaire. The open-ended questions were answered briefly by a few students, which was insufficient to address the research questions. However, the group interview was a vital method for the researcher to obtain sufficient data.

This process was followed by taking into consideration the time limit and effort involved. Moreover, the data were collected in Arabic as the participants felt more comfortable speaking in their native language. Transcribing and translating thedata into English was quite difficult as the students and lecturers resided in

different parts of Saudi Arabia which meant regional differences in dialect or pronunciation changed the meanings of some words. Thus, transcribing and translating into English took a lot of time. Care was taken to ensure the data is an accurate representation of what the participants reported. In addition, some participants were invited to engage in interpreting the data. That was carried out through Skype, due to travel constraints. Furthermore, the findings were sent to participants after transcription and translation to ensure the findings represented what they felt. There was not possibility to measure students' performance, as result of data protection for the students and not having permission to access students grades before and after using PRS. Having access to the students grades would inform the research of the students' performance.

All phases of data collection were informed by GT; this began with memo writing to record the process of collecting and analysing data. These memos were later coded to identify patterns of words related to the use of PRS and the learning process, then Axial coding was applied to group the codes and finally generate themes in a selective coding phase. The findings were applied to AT. The second generation of AT was chosen to analyse the use of PRS. However, the findings indicated there are differences between the students and lecturers in terms of the objectives. These differences have led to the conceptualization of two different activity systems with different roles and rules.

The combination between GT and AT was not a simple task, but it has illustrated a clear view of using PRS for teaching and learning. Therefore, rich data WAS achieved by following the phases of GT, resulting in the relationships between the themes becoming clear and tangible. The improvement in the learning process and educational environment was deeply investigated, based on the relationships between the components. AT acted as the lens to analyse the

relationships.

The third generation of AT was chosen to examine the two different activity systems. Choosing the third generation has helped illustrate the interaction between the components of the activity, representing two activity systems for the students and the lecturer. The differences between the activity systems include objectives, rules and roles. The use of AT was a successful approach to analyse the use of PRS, because this analysis revealed differences in terms of objectives. Both students and lecturers aim to improve understanding and learning. However, the students are working to improve their understanding by engaging in the activity and fulfilling their roles to construct their learning. Lecturers are working to help students to understand the content by fulfilling their role and applying the rules. This difference has made the PRS activity fit into two activities systems for both students and lecturers, with a shared objective for both of understanding the content.

3. The implications of the study on students and lecturers

The main findings show how students' activities are linked to their roles and rules in the PRS activity. The rules mediate the relationship between students (subjects), and between other students and lecturers. The roles for the individuals in the activity help to transform the objective into outcomes. The rules for the students involve answering questions, asking questions of the lecturer or other students, discussing and justifying choices, and concentrating during the lecture. Applying these rules will help students to construct their understanding of the content. The use of PRS has helped change the rules for learning for students within the learning environment. This change has given students more responsibility towards their understanding and towards other students' understanding. These responsibilities mean the mode of learning has changed

from transmissive learning to more constructive learning with greater interactivity.

The rules for the students have changed compared to the traditional lecture. Instead of being listeners receiving the information from the lecturer during class, students have become an essential part of the learning process. Moreover, they need to act by answering the questions and consider the content in order to choose the right answer, increasing students' participation. In addition, students need to interact with their peers during the learning process, which is a new role for the student. The lecturer's role has changed from delivering the information to supervising or guiding the learning activity. Therefore, the study reveals the positive implications of using PRS.

These changes have come about because each aspect of the learning environment, as shown in their representation in an activity system, is linked and so a change in one – when PRS is introduced as a mediating artefact – effects all of the others. However, this depends on the way PRS is used as a mediating artefact. The other pattern of using PRS is at the end of lecture, which produces a result similar to transmissive learning, was supported by only a few participants. Here the impact of PRS is less pronounced. The students prefer to act as they used to do in the traditional lecture by listening to the lecturer during class time and taking notes. Lecturers think using PRS at the end of lecture will save time and reduce the possibility for any distraction. However, this does not allow interaction between individuals during the learning process. Therefore, the students might only memorize the information, which represents a superficial level of learning. However, this pattern will not help students to focus during lectures as the literature review suggested students focus for a maximum of 20 minutes at a time. Therefore, with this pattern of using PRS there is more possibility for distraction.

The findings indicate PRS can also have negative effects on the students' learning and the general education environment. These negative effects are either uncommon or do not occur regularly. The technical issues are the most common problem for users of PRS. However, these technical issues tend to be fixed during the lecture; comparatively few technical issues need to be fixed by a technical support team. Notwithstanding, the learning process is sometimes disrupted by these issues and may cause confusion for the students or lecturers. The other negative aspect of using PRS is not applying the rules for the activity.

4. The implications for policy makers and universities

Generally, the findings of this study show positive changes to the educational environment and the learning activates. Increasing participation is one of the positive changes compared to the traditional lecture.

In the sample, attendance has increased to around 85% with PRS compared to the traditional lecture, therefore the possibility of learning development seems higher with PRS. The affordance of PRS encourages students to answer questions, and answer more than one question during a lecture. This may inform policy makers and universities about the importance of technology and the possibilities of changing traditional learning in the Saudi context to a more interactive learning system. The findings suggest development in learning levels. Learning has moved from merely memorizing the information towards analysing information to applying concepts and evaluating information. Furthermore, there is evidence of increased collaboration among students. These benefits will encourage universities and policy makers to consider using technology to support their lecturers and students. The findings

reveal that universities need to offer more training and support for the staff to understand the potential of using technology for teaching and learning.

Generally, PRS was an effective learning technology for the learning process and the educational environment. PRS has offered students and lecturers a new learning strategy for the students, where they can contribute to their learning and to another students' learning. This strategy has proved that learning is a social interaction between the individuals in the educational environment. With PRS the learning no longer relies solely on the lecturer, but the students need to interact to construct their learning by applying the rules to implement their roles. Any constraints will effect the whole activity. Therefore, PRS has developed learning for students and teaching for lecturers, despite a few negative aspects the users may face.

5. Implications of using AT

In this study, AT was used as a framework and lens to understand and interpret data related to the PRS activities. The principles of AT were a significant influence on the research, especially around planning, developing the research questions and defining the procedures for collecting data. Using AT has been an effective approach to analyse and understand PRS activity, the learning process and the relationships between components. AT reveals how the different elements of any learning environment link to each other, so that a change in one node may have an impact on the others. AT has also drawn attention to the importance of increasing interaction and switching to more constructivist learning (Engestrom, 2001). Combining AT and GT in the Saudi context is an important contribution to understanding the use of PRS for learning development. This understanding was built by considering every component of the PRS activity, which is essentially

related to the learning process. Additionally, the constraints of the PRS activity, explored by AT, have helped to improve the activity. This may be applied to other studies about learning technologies in the Saudi context.

6. Recommendations

Despite the substantial budget allocated for learning development and to increasing the quality of teaching and learning from the HEIs in Saudi Arabia, there is still a great deal of work to be done to achieve that goal (Ministry of Education, 2014). The use of technology is one aspect needing to be developed in terms of implementation. In other words, Saudi Higher Education institutions are equipped with new technologies; however, there is no clear strategy or policy for using technologies for teaching and learning. The aim of using technology in this context should be improving and enhancing learning development and having better teaching and learning experiences, rather than because a technology is novel. The findings show there is a lack of technical support as lecturers and students do not have enough support. In some cases, lecturers needed to book a time to meet a technician to solve problems or to get advice but that was not available. This hindered many lecturers when they used technologies for teaching. Therefore, universities need to provide more technical support to allow lecturers to use technology effectively. It is worth noting, though, that this is not a particularly sophisticated technology, and yet it has had a positive impact on learning environments and outcomes. Hence, expenditure does not need to be great to make a difference.

The findings in this study inform the Ministry of Education of the importance of showing the users the potential benefits of using technology in education. Providing information about the most suitable technology for each situation will

help them achieve their objectives. At the beginning of data collection, seminars were provided for lecturers to inform them of PRS and its possible uses. This was sufficient encouragement for some lecturers to use this technology for teaching. Although there are many technologies available in the university, the lecturers do not know about them or how best to use them. Therefore, universities need to provide seminars about using technologies for teaching, along with possible or ideal methods of implementation. This occurs through making a systemic strategy to incorporate technology into education, considering all the aspects (lecturers, students, types of technology and curriculums).

These findings show the importance of planning for lectures when using PRS to make sure the objectives of using this technology will be achieved. It is essential to spend more time and effort to plan for lectures, particularly when using PRS. Many constraints occur as a result of not using PRS properly. The students need to know the importance of using this technology to apply the rules of the activity, which could be achieved through increasing their awareness by offering seminars or providing online information. In some cases, students were not motivated to use this technology, so emphasising the importance of the technology on them is vital.

Furthermore, it is vital for the university to choose the most suitable version of PRS to integrate into classrooms. In the university, there were three types of PRS at the time the data were collected; two of them were incompatible with the available operating systems and it was difficult to use them in lectures for both students and lecturers. On the other hand, the PRS used in the study featured basic functions, making it easy to use and understand. For example, only multiple-choice questions and rating questions were supported by the system.

Introducing more advanced PRS will allow lecturers to ask a variety of questions, including open-ended questions. Moreover, the possibility for recording the questions and results and uploading it to Blackboard will be helpful. This feature will encourage students to revise the questions and answers after each question to increase their understanding.

It would be beneficial for the students to encourage them to discuss the concept under examination after each question in English. The anonymity of the answers will encourage students to become involved in the discussion, and carrying out the discussion in English will improve students' communication skills to enable them to ask the lecturer for further clarification. However, the number of the students discussing a question and the time allowed for discussion needs to be appropriate, so the lecturer maintains control of the class. The importance of the rules of the activity cannot be emphasised enough. Using PRS without applying the rules will not help achieve the learning objectives.

The findings recommended using PRS as tool to evaluate students' understanding and provide more clarification. This will help improve the outcomes of the learning since the proposed questions focused on the most important points of the lecture. Additionally, lecturers should use the results generated by PRS as criteria to assess their teaching style. The high percentage of wrong answers will highlight weaknesses in teaching styles that must be addressed.

In terms of using PRS for learning, the findings recommend using PRS during the lecture to support interaction and constructivist learning. Using PRS at the end of lecture will not make enough of a change to the predominant learning style, the traditional lecture, where students listen to the lecture and take notes. Students need to construct their learning by engaging in the learning process. Using PRS

during the lecture instead of only at the end of it is a successful strategy to achieve that.

7. Further research

The findings show improvement in the education environment through the facilitation and encouragement of more interaction. The strategy of using PRS during the lecture, asking questions and encouraging students to answer them was vital to make these changes. However, including many universities and schools in additional studies might benefit from the application of this technology. Moreover, research into using PRS with different subjects would be advantageous to demonstrate the differences between and potential benefits of each context. In addition, applying different research approaches might be helpful to improve the use of PRS in Saudi Universities. For example, comparison between using PRS in the field of education in the UK and Saudi Arabia could be useful since PRS was introduced several years ago in British universities.

In terms of the sample, it would be more effective to have a bigger range from different universities to obtain diverse perspectives. That can be done by including undergraduate and postgraduate courses and workshops. Considering the research tools, the questionnaire methods might be perfect to generalise the findings with a large number of the participants. This study revealed the positive influence of PRS on interaction and the learning process. Further research may be conducted to investigate the effectiveness of interventions on the learning process and interaction in secondary, intermediate and elementary schools in Saudi Arabia. The findings of this study raise the possibility of improving performance for Saudi students, especially at the public schools where the number of the students is large in comparison to the private schools.

There is a dearth of possible instruments to measure the effectiveness of using PRS to improve learning outcomes. In this study the researcher did not have access to the exam marks to observe the differences between students taught with PRS or without it and the time for collecting data was limited. From this perspective, more research should be conducted to develop and validate relevant instruments to measure learning outcomes which result from a PRS based learning process. This will help to enhance the validity and generalisability of future research outcomes in such contexts.

This study was carried out in the male section of one university in the south of Saudi Arabia, with a reasonable number of students. Attempting to generalise the findings of this research might therefore reveal some gender issues; it is recommended that further research should include both male and female participants with a larger sample population. Additionally, a study of this nature might be carried out again using a long-term longitudinal study design where PRS is used individually or within groups, and with more advanced forms of PRS. Longitudinal research would be of benefit if we are trying to implement an intervention/training programme to see its success in improving PRS among students. The possibility of improving English language skills may be examined more deeply with a long-term research design.

The outcomes of the study have demonstrated that the PRS is an effective teaching strategy in lectures in comparison to the traditional lecture format in Saudi universities, which is based on teacher-centred learning. It would be beneficial for future research to look at the strategy and pedagogy of using PRS for teaching. The findings show different views of using PRS, based on preference or on the effectiveness of using this technology. Therefore, looking at

teaching strategy will be a useful approach to increase the effectiveness of using this technology for teaching. Future research should focus on the type and phrasing of questions to ensure they are suitable to encourage constructivist approaches to learning and effective at encouraging student participation.

The efficacy of PRS and how much the students enjoyed using this technology was reported in this study. However, as the novelty of PRS wears off, students may grow bored and it may lose its motivational power. This study does not indicate any evidence of continuing interest for students to use this technology. There is the possibility that students will lose interest over time, especially if the lecturer keeps using the same strategy and basic software features. Eventually PRS may find its place in storage with old tools if the users lose interest in using this technology. Therefore, it is essential to find out how PRS would be able to sustain students' interest with the same efficiency for learning processes.

In this study, the evidence suggests that the use of this technology was an effective strategy for teaching. Although many lecturers refused to use it at the beginning because it was new for them, the workshops were provided at the beginning of the study encouraged them to use the technology. Therefore, lecturers would benefit from more effective workshops to implement technology in their lectures for teaching. Further research into policies and workshops to encourage use of this technology and establishing programs to help lecturers to use technology effectively could be of great benefit.

References:

Abrahamson, L. (2006) 'A brief history of networked classrooms: Effects, cases, pedagogy, and implications', *Audience response systems in higher education: Applications and cases.* IGI Global, pp. 1-25.

Agbatogun, A. O. (2013) 'Comparative effect of interactive mobiles (clickers) and communicative approach on the learning outcomes of the educationally disadvantaged Nigerian pupils in ESL classrooms'.

Agbatogun, A. O. (2014) 'Developing Learners' Second Language Communicative Competence through Active Learning: Clickers or Communicative Approach?'. *Journal of Educational Technology & Society*, 17 (2), pp. 257-269.

Al-Abdulkareem, R. & Hentschke, G. C. (2014) 'Textbooks and Constructivist Pedagogy in Saudi Arabian School Classrooms'. *Journal of Curriculum and Teaching*, 3 (2), pp. p13.

Al Kuwaiti, A. & Subbarayalu, A. V. (2015) 'Appraisal of students experience survey (SES) as a measure to manage the quality of Higher Education in the Kingdom of Saudi Arabia: An institutional study using six sigma model'. *Educational Studies*, 41 (4), pp. 430-443.

Alamri, M. (2011) 'Higher Education in Saudi Arabia'. *Journal of Higher Education Theory and Practice*, 11 (4), pp. 88-91.

Albion, P. R. & Ertmer, P. A. (2002) 'Beyond the foundations: The role of vision and belief in teachers' preparation for integration of technology'. *TechTrends*, 46 (5), pp. 34-38.

Albon, R. J. & Jewels, T. (2007) 'The impact of audience response systems in a multicultural Asian context', *ICT: Providing choices for learners and learning. Proceedings ascilite Singapore 2007*.

Alderman, L., Towers, S. & Bannah, S. (2012) 'Student feedback systems in higher education: A focused literature review and environmental scan'. *Quality in Higher education*, 18 (3), pp. 261-280.

Alebaikan, R. & Troudi, S. (2010) 'Blended learning in Saudi universities: challenges and perspectives'. *Research in Learning Technology*, 18 (1),

Alfahad, F. N. (2012) 'Effectiveness of using information technology in higher education in Saudi Arabia'. *Procedia-Social and Behavioral Sciences*, 46 pp. 1268-1278.

Algahtani, A. (2011) *Evaluating the Effectiveness of the E-learning Experience in Some Universities in Saudi Arabia from Male Students' Perceptions*. Durham University.

Alkhalaf, S., Drew, S., AlGhamdi, R. & Alfarraj, O. (2012) 'E-Learning system on higher education institutions in KSA: attitudes and perceptions of faculty members'. *Procedia-Social and Behavioral Sciences*, 47 pp. 1199-1205.

Allen, D. K., Brown, A., Karanasios, S. & Norman, A. (2013) 'How Should Technology-Mediated Organizational Change Be Explained? A Comparison of the Contributions of Critical Realism and Activity Theory'. *Mis Quarterly*, 37 (3), pp. 835-854.

Almalki, A. M. (2011) *Blended learning in higher education in Saudi Arabia: A study of Umm Al-Qura University*. RMIT University.

Alrouqi, F. (2015) *THE IMPACT OF "CLICKERS" ON STUDENT ACHIEVEMENT IN SECOND GRADE MATH CLASS*. State University of New York at Fredonia.

Alsulami, S. (2016) 'Toward a Constructivist Approach in Saudi Education'. *English Language Teaching*, 9 (12), pp. 104.

Alzaydi, D. A. (2010) *Activity theory as a lens to explore participant perspectives of the administrative and academic activity systems in a university–school partnership in initial teacher education in Saudi Arabia*. University of Exeter.

Amoudi, K. K. & Sulaymani, O. (2014) 'THE INTEGRATION OF EDUCATIONAL TECHNOLOGY IN GIRLS' CLASSROOMS IN SAUDI ARABIA'. *European Journal of Training and Development Studies*, 1 (2), pp. 14-19.

Arnseth, H. C. (2008) 'Activity theory and situated learning theory: contrasting views of educational practice'. *Pedagogy, Culture & Society*, 16 (3), pp. 289-302.

Aspers, P. (2004) 'Empirical phenomenology: An approach for qualitative research'. *London School of Economics and Political science (Ed.), Social research methods. Qualitative series*, (9),

Austin, K., Orcutt, S. & Rosso, J. (2001) 'How people learn: Introduction to learning theories'. http://www.stanford.edu/class/ed269/hplintrochapter.pdf,

Awedh, M., Mueen, A., Zafar, B. & Manzoor, U. (2015) 'Using Socrative and Smartphones for the support of collaborative learning'. *arXiv preprint arXiv:1501.01276*,

Bandaranaike, S. & Willison, J. (2011) 'Engaging students in work integrated learning: drives and outcomes', Education, P.o.W.t.W.C.o.C.W.-i. (ed. *WACE 17th World Conference on Cooperative & Work-integrated Education*. Philadelphia, PA, USA. 4-17 June 2011. pp. pp. 1-12.

Bhaskar, R. (1979). The possibility of naturalism: A philosophical critique of the contemporary human sciences, Routledge.

Bhaskar, R. (1986). Scientific Realism and human emancipation. Realizing Social Science Knowledge, Springer**:** 29-51.

Bhaskar, R. (1989). Reclaiming reality: A critical introduction to contemporary philosophy, Routledge.

Levy, D., et al. (2017). "Getting an honest answer: Clickers in the classroom." Journal of the Scholarship of Teaching and Learning **17**(4): 104-125.

Bandura, A. (1976) 'Self-reinforcement: Theoretical and methodological considerations'. *Behaviorism*, pp. 135-155.

Barab, S. A., Barnett, M., Yamagata-Lynch, L., Squire, K. & Keating, T. (2002) 'Using activity theory to understand the systemic tensions characterizing a technology-rich introductory astronomy course'. *Mind, Culture, and Activity*, 9 (2), pp. 76-107.

Barber, M. & Njus, D. (2007) 'Clicker evolution: seeking intelligent design'. *CBE-Life Sciences Education*, 6 (1), pp. 1-8.

Barragués, J., Morais, A. & Guisasola, J. (2011) 'Use of a classroom response system (CRS) for teaching mathematics in Engineering with large groups'. *Education in a technological world: Communicating current and emerging and technological efforts*, pp. 572-580.

Batiuk, M. E. & Sacks, H. L. (1981) 'George Herbert Mead and Karl Marx: Exploring Consciousness and Community'. *Symbolic Interaction*, 4 (2), pp. 207-223.

Beatty, I. D. (2004) 'Transforming student learning with classroom communication systems'.
Educause Center for Applied Research (ECAR) Research Bulletin ERB0403,

Beatty, I. D., Gerace, W. J., Leonard, W. J. & Dufresne, R. J. (2006) 'Designing effective questions for classroom response system teaching'. *American Journal of Physics*, 74 (1), pp. 31- 39.

Bedny, G. Z. & Harris, S. R. (2005) 'The systemic-structural theory of activity: applications to the study of human work'. *Mind, culture, and Activity*, 12 (2), pp. 128-147.

Beekes, W. (2006) 'The 'millionaire'method for encouraging participation'. *Active learning in higher education*, 7 (1), pp. 25-36.

Blaxter, L., Hughes, C. & Tight, M. (2010) *How to research.* McGraw-Hill Education (UK).

Blood, E. & Neel, R. (2008) 'Using student response systems in lecture-based instruction: Does it change student engagement and learning?'. *Journal of Technology and Teacher Education*, 16 (3), pp. 375-383.

Bødker, S. (1996) 'Creating conditions for participation: Conflicts and resources in systems development'. *Human-computer interaction*, 11 (3), pp. 215-236.

Bomia, L., Beluzo, L., Demeester, D., Elander, K., Johnson, M. & Sheldon, B. (1997) 'The Impact of Teaching Strategies on Intrinsic Motivation'. *ERIC*,

Bousbahi, F. (2014) 'Use of i-clickers to enhance learning outcomes assessment in classroom: A Case Study in King Saud University'. *International Journal of Teaching and Education*, II (4),

Bowler, L., Large, A., Beheshti, J. & Nesset, V. (2005) 'Children and adults working together in the zone of proximal development: A theory for user-centered design', *Proceedings of the Canadian Association for Information Science 2005 Annual Conference*. pp. 2-4.

Braun, V. & Clarke, V. (2006) 'Using thematic analysis in psychology'. *Qualitative research in psychology*, 3 (2), pp. 77-101.

Braxton, J. M., Milem, J. F. & Sullivan, A. S. (2000) 'The influence of active learning on the college student departure process: Toward a revision of Tinto's theory'. *Journal of higher education*, pp. 569-590.

Browaeys, M.-J. (2004) 'Complexity of epistemology: Theory of knowledge or philosophy of science', *Fourth Annual Meeting of the European Chaos and Complexity in Organisations Network*. pp. 2-3.

Bruff, D. (2007) 'Clickers: A classroom innovation'. *National Education Association Advocate*, 25 (1), pp. 5-8.

Bruff, D. (2012) 'Classroom Response Systems (Clickers)'. *Vanderbilt University*. [Online]. Available at: https://cft.vanderbilt.edu/guides-sub-pages/clickers/ (Accessed: 2 Feb 2016).

Bruun, H. H. (2012) *Science, Values and Politics in Max Weber's Methodology: New Expanded Edition.* Ashgate Publishing, Ltd.

Buabeng-Andoh, C. (2012) 'Factors influencing teachers' adoption and integration of information and communication technology into teaching: A review of the literature'. *International Journal of Education and Development using Information and Communication*

Technology, 8 (1), pp. 136.

Bullock, D., LaBella, V., Clingan, T., Ding, Z., Stewart, G. & Thibado, P. (2002) 'Enhancing the student – instructor interaction frequency'. *The Physics Teacher*, 40 (9), pp. 535-541.

Burnstein, R. A. & Lederman, L. M. (2001) 'Using wireless keypads in lecture classes'. *The Physics Teacher*, 39 (1), pp. 8-11.

Burr, V. (1995) *An introduction to social constructionism.* London: Routlegde. 1st Edition edn. London: Routledge.

Burr, V. (2015) *Social constructionism.* 3d edition edn. London & New Yourk: Routledge.

Bush, G. (2006) 'Learning about learning: from theories to trends'. *Teacher Librarian*, 34 (2), pp. 14.

Butler, A., Phillmann, K.-B. & Smart, L. (2001) 'Active learning within a lecture: Assessing the impact of short, in-class writing exercises'. *Teaching of Psychology*, 28 (4), pp. 257-259.

Caldwell, J. E. (2007) 'Clickers in the large classroom: Current research and best-practice tips'. *CBE-Life Sciences Education*, 6 (1), pp. 9-20.

Campbell, T. (1997) 'Technology, multimedia, and qualitative research in education'. *Journal of Research on Computing in Education*, 30 (2), pp. 122-132.

Campos, D. F. & Pinto, M. M. F. (2016) 'Mathematics teachers' conceptions and constraints for changing teaching practices in Brazilian higher education: an analysis through activity theory'. *International Journal of Mathematical Education in Science and Technology*, 47 (8), pp. 1179-1205.

Central Department of Statistics (2014) *Estimates Of Population By Sex And Nationality (Saudi / Non Saudi) In The Kingdom For The Years (2004 To 2014).* Riyadh: Central Department of Statistics. 1 pp. Available at: http://www.cdsi.gov.sa/socandpub/resd.

Chaiklin, S. E., Hedegaard, M. E. & Jensen, U. J. E. (1999) 'Activity theory and social practice', *Congress of the International Society for Acitivty Theory & Cultural Research, 4th, Jun, 1998, Aarhus, Denmark; The contributions in this book are revised versions of keynote lectures and invited panel presentations from the aforementioned meeting.* Aarhus University Press.

Charmaz, K. (2003) 'Grounded theory'. *Qualitative psychology: A practical guide to research methods*, pp. 81-110.

Charmaz, K. (2006) 'Constructing grounded theory: A practical guide through qualitative research'. *SagePublications Ltd, London*,

Charmaz, K. (2008) 'Constructionism and the grounded theory method'. *Handbook of constructionist research*, 1 pp. 397-412.

Chung, G. K., Shel, T. & Kaiser, W. J. (2006) 'An exploratory study of a novel online formative assessment and instructional tool to promote students' circuit problem solving'. *The Journal of Technology, Learning and Assessment*, 5 (6),

Churches, A. (2008) 'Bloom's digital taxonomy'. 2017. [Online]. Available at: http://burtonslifelearning.pbworks.com/f/BloomDigitalTaxonomy2001.pdf (Accessed: 13 Dec 2016).

Clements, D. H. (1997) '(Mis?) constructing constructivism'. *Teaching children mathematics*, 4 (4), pp. 198.

Cohen, L., Manion, L. & Morrison, K. (2000) 'Research Methods in Education [5 th edn] London: Routledge Falmer'. *Teaching in Higher Education*, 41

Cohen, L., Manion, L. & Morrison, K. (2013) *Research methods in education.* Routledge.

Corbin, J. M. & Strauss, A. (1990) 'Grounded theory research: Procedures, canons, and evaluative criteria'. *Qualitative sociology*, 13 (1), pp. 3-21.

Cowley, J., Chanley, S., Downes, S., Holstrom, L., Ressel, D., Siemens, G. & & Weisburgh, M. (2002) 'Interaction '. [Online]. Available at: http://www.elearnspace.org/Articles/Interaction.htm (Accessed: 27 August).

Crawford, K. & Hasan, H. (2006) 'Demonstrations of the activity theory framework for research in information systems'. *Australasian Journal of Information Systems*, 13 (2),

Cresswell, J. W. (1998) 'Qualitative inquiry and research design: Choosing among five traditions'.[in london: Sage Publications. p. 51. (Accessed:Cresswell, J. W.

Creswell, J. W. (2007) *Qualitative inquiry & research design: Choosing among the five approaches* ed. Oaks,

T., CA: Sage.

Creswell, J. W. (2013) *Research design: Qualitative, quantitative, and mixed methods approaches.* 3d edn. Sage publications.

Creswell, J. W. (2014) *Research design: Qualitative, quantitative, and mixed methods approaches.* 4th edn. Sage publications.

Crews, T. B., Ducate, L., Rathel, J. M., Heid, K. & Bishoff, S. T. (2011) 'Clickers in the classroom: Transforming students into active learners'. *ECAR Research Bulletin*, 9 pp. 502.

Crooks, D. L. (2001) 'The importance of symbolic interaction in grounded theory research on women's health'. *Health Care for Women International*, 22 (1-2), pp. 11-27.

Crotty, M. (1998) *The foundations of social research: Meaning and perspective in the research process.* London: Sage.

Crotty, M. (2003) 'The foundation of social research: Meaning and Perspective in the research process'. *London, UK*,

Crouch, C. H. & Mazur, E. (2001) 'Peer instruction: Ten years of experience and results'. *American journal of physics*, 69 (9), pp. 970-977.

Cruickshank, J. (2011) 'The positive and the negative: assessing critical realism and social constructionism as post-positivist approaches to empirical research in the social sciences'. *International Migration Institute Working Papers*, 42

Cutcliffe, J. R. & Harder, H. G. (2012) 'Methodological Precision in Qualitative Research: Slavish Adherence or" Following the Yellow Brick Road?"'. *The Qualitative Report*, 17 (41), pp. 1.

Cutts, Q. (2006) 'Practical lessons from four years of using an ARS in every lecture of a large class'. *Audience response systems in higher education*, pp. 65-79.

Cutts, Q., Carbone, A. & Van Haaster, K. (2004) 'Using an electronic voting system to promote active reflection on coursework feedback', *Proceedings of Intl. Conf. on Computers in Education, Melbourne, Australia*. Australia 30th Nov - 3d Dec 2004. N.

D'Inverno, R., Davis, H. & White, S. (2003) 'Using a personal response system for promoting student interaction'. *Teaching Mathematics and its applications*, 22 (4), pp. 163-169.

Dagarin, M. (2004) 'Classroom interaction and communication strategies in learning English as a foreign'. *Ljubljana: ELOPE*,

Daniel, T. & Tivener, K. (2016) 'Effects of sharing clickers in an active learning environment'. *Educational Technology & Society*, 19 (3), pp. 260-269.

Day, D. & Lloyd, M. M. (2007) 'Affordances of online technologies: More than the properties of the technology'. *Australian Educational Computing*, 22 (2), pp. 17-21.

DeBourgh, G. A. (2008) 'Use of classroom "clickers" to promote acquisition of advanced reasoning skills'. *Nurse Education in Practice*, 8 (2), pp. 76-87.

Desai, V. & Potter, R. B. (2006) *Doing development research.* London: Sage.

Dihoff, R. E., Brosvic, G. M., Epstein, M. L. & Cook, M. J. (2004) 'Provision of Feedback During Preparation for Academic Testing: Learning is Enhanced by Immediate but not Delayed Feedback'. *The Psychological Record*, 54 (2), pp. 4.

Douglas, J. & Douglas, A. (2006) 'Evaluating teaching quality'. *Quality in Higher education*, 12 (1), pp. 3-13.

Draper, S. W. & Brown, M. I. (2004) 'Increasing interactivity in lectures using an electronic voting system'. *Journal of computer assisted Learning*, 20 (2), pp. 81-94.

Draper, S. W., Cargill, J. & Cutts, Q. (2002) 'Electronically enhanced classroom interaction'. *Australasian Journal of Educational Technology*, 18 (1),

Duncan, D. (2008) 'Tips for successful "clicker" use'. [in University of Colorado Available at http://www. cwsei. ubc. ca/resources/files/Tips_for_Successful_Clicker_Use_Duncan. pdf [retrieved on 26/09/2013]. Available at: http://casa.colorado.edu/~dduncan/clickers/Tips.pdf (Accessed:12 MAY 2016.

Duncan, D. K., Hoekstra, A. R. & Wilcox, B. R. (2012) 'Digital devices, distraction, and student performance: Does in-class cell phone use reduce learning'. *Astronomy education review*, 11 (1), pp. 1-4.

Duruji, M., Azuh, D. E., Joshua, S., Olanrewaju, I. & Okorie, U. (2015) 'Teaching Method and Assimilation of Students in Tertiary Institutions: A Study of Covenant University, Nigeria'.

Eastman, J. K. (2007) 'Enhancing classroom communication with interactive technology: How faculty can get started'. *College Teaching Methods & Styles Journal (CTMS)*, 3 (1), pp. 31-38.

Edwards, A. (2007) 'Relational agency in professional practice: A CHAT analysis'. *an international journal of human activity theory*,

Egelandsdal, K. & Krumsvik, R. J. (2017) 'Clickers and formative feedback at university lectures'. *Education and Information Technologies*, 22 (1), pp. 55-74.

El-Rady, J. (2006) 'To click or not to click: That's the question'. *Innovate: Journal of online education*, 2 (4), pp. 6.

El Mansour, B. & Mupinga, D. M. (2007) 'STUDENTS' POSITIVE AND NEGATIVE EXPERIENCES IN HYBRID AND ONLINE CLASSES'. *College student journal*, 41 (1), pp. 242.

Ellingson, L. L. (2009) *Engaging crystallization in qualitative research: An introduction.* Sage.

Engestrom, Y. (1999) '23 Innovative learning in work teams: Analyzing cycles of knowledge creation in practice'. *Perspectives on activity theory*, 377

Engeström, Y. (1993) 'Developmental studies of work as a testbench of activity theory: The case of primary care medical practice'. *Understanding practice: Perspectives on activity and context*, pp. 64-103.

Engeström, Y. (2001) 'Expansive learning at work: Toward an activity theoretical reconceptualization'. *Journal of Education and Work*, 14 (1), pp. 133-156.

Engeström, Y. (2008) 'Weaving the texture of school change'. *Journal of Educational Change*, 9 (4), pp. 379-383.

Engeström, Y. & Middleton, D. (1998) *Cognition and communication at work.* Cambridge University Press.

Engeström, Y., Miettinen, R. & Punamäki, R.-L. (1999) *Perspectives on activity theory.* Cambridge, The UK: Cambridge University Press.

Fan, K. & van den, B. (2006) 'a compression and evaluation of Personal response system in introductory programme', *Proceedings of the 2006 Annual ASEE Conference*. USA.

Fernyhough, C. (2008) 'Getting Vygotskian about theory of mind: Mediation, dialogue, and the development of social understanding'. *Developmental review*, 28 (2), pp. 225-262.

FitzPatrick, K. A., Finn, K. E. & Campisi, J. (2011) 'Effect of personal response systems on student perception and academic performance in courses in a health sciences curriculum'. *Advances in Physiology Education*, 35 (3), pp. 280-289.

Fleetwood, S. (2005) 'Ontology in organization and management studies: A critical realist perspective'. *Organization*, 12 (2), pp. 197-222.

Fleetwood, S. (2014) 'Bhaskar and critical realism', in Adler, P., Du Gay, P., Morgan, G. and Reed, M. (eds.) *Oxford Handbook of Sociology, Social Theory and Organization Studies: Contemporary Currents.* 1st edn. Oxford, The UK: OXFORD University Press, pp. 182.

Floyd, K. S., Harrington, S. J. & Santiago, J. (2009) 'The effect of engagement and perceived course value on deep and surface learning strategies'. *Informing Science: the International Journal of an Emerging Transdiscipline*, 12 pp. 181-190.

Gachago, D., Morris, A. & Simon, E. (2011) 'Engagement levels in a graphic design clicker class: Students' perceptions around attention, participation and peer learning'. *Journal of Information Technology Education: Research*, 10 (1), pp. 253-269.

Gauci, S. A., Dantas, A. M., Williams, D. A. & Kemm, R. E. (2009) 'Promoting student-centered active learning in lectures with a personal response system'. *Advances in Physiology Education*, 33 (1), pp. 60-71.

Geer, R. & Sweeney, T.-A. (2012) 'Students' voices about learning with technology'. *Journal of social sciences*, 8 (2), pp. 294.

Gibson, J. J. (1977) 'The theory of affordances'. *Hilldale, USA*,

Gill, J. & Johnson, P. (2010) *Research methods for managers.* 4th edn. london: Sage.

Golafshani, N. (2003) 'Understanding reliability and validity in qualitative research'. *The qualitative report*, 8 (4), pp. 597-606.

Gordon, P. (2009) 'Korean speakers' acquisition of the English ditransitive construction: The role of verb prototype, input distribution, and frequency'. *The Modern Language Journal*, 93 (3), pp. 399-417.

Goulding, C. (1998) 'Grounded theory: the missing methodology on the interpretivist agenda'. *Qualitative Market Research: An International Journal*, 1 (1), pp. 50-57.

Grasha, A. F. & Yangarber-Hicks, N. (2000) 'Integrating teaching styles and learning styles with instructional technology'. *College Teaching*, 48 (1), pp. 2-10.

Guiller, J. & Bell, D. (2011) 'who wants an interactive lecture: Embedding use of Personal System to Enhance the Student Learning Experince', The Higher Education Academy [Online]. Available at: https://www.heacademy.ac.uk/sites/default/files/guiller_and_bell_final_report.pdf (Accessed: 12 March 2016).

Guk, I. & Kellogg, D. (2007) 'The ZPD and whole class teaching: Teacher-led and student-led interactional mediation of tasks'. *Language Teaching Research*, 11 (3), pp. 281-299.

Hamilton, L. (2011) 'Case studies in educational research'. *British Educational Research Association*,

Hancock, T. M. (2010) 'Use of audience response systems for summative assessment in large classes'. *Australasian Journal of Educational Technology*, 26 (2), pp. 226-237.

Hasan, H. (1999) 'Integrating IS and HCI using activity theory as a philosophical and theoretical basis'. *Australasian Journal of Information Systems*, 6 (2),

Hauge, T. E. & Dolonen, J. (2012) 'Towards an activity-driven design method for online learning resources'. *AD Olofsson & OJ Lindberg: Informed Design of Educational Technologies in Higher Education. Hershey: IGI Global*, pp. 101-117.

Havill, D. (2007) 'Piloting a personal response system at an Arabic university', *World Conference on Educational Multimedia, Hypermedia and Telecommunications*. Vancouver, Canada pp. 2219-2228.

Hayes, D. (2006) 'Case Study'. Plymouth University [Online]. Available at: http://www.edu.plymouth.ac.uk/resined/Case_study/casest.htm (Accessed: 28 September).

Hedlund-deWitt, N. (2013) *Critical Realism: A synoptic overview and resource guide for Integral scholars.* Available at: https://foundation.metaintegral.org/sites/default/files/Critical%20Realism_4-12-2013.pdf.

Hein, G. (1991) 'Constructivist learning theory', Conference, C.I.C.o.M.E. (ed. *Institute for Inquiry. Available at:/http://www. exploratorium. edu/ifi/resources/constructivistlearning. htmlS*. Jerusalem Israel 15-22 October 1991 Lesley College. Massachusetts USA

Heiner, C. E., Banet, A. I. & Wieman, C. (2014) 'Preparing students for class: How to get 80% of students reading the textbook before class'. *American Journal of Physics*, 82 (10), pp. 989-996.

Heinerichs, S., Pazzaglia, G. & Gilboy, M. B. (2016) 'Using Flipped Classroom Components in Blended Courses to Maximize Student Learning'. *Athletic Training Education Journal*, 11 (1), pp. 54-57.

Henning, E., Van Rensburg, W. & Smit, B. (2004) 'Finding your way in qualitative research'.

Henriques, G. (2014) 'In Search of Collective Experience and Meaning: A Transcendental Phenomenological Methodology for Organizational Research'. *Human Studies*, 37 (4), pp. 451- 468.

Herreid, C. F. (2006) '" Clicker" Cases'. *Journal of College Science Teaching*, 36 (2), pp. 43.

Herrett, E., Thomas, S. L., Schoonen, W. M., Smeeth, L. & Hall, A. J. (2010) 'Validation and validity of diagnoses in the General Practice Research Database: a systematic review'. *British journal of clinical pharmacology*, 69 (1), pp. 4-14.

Hodkinson, P. & Hodkinson, H. (2001) 'The strengths and limitations of case study research', *Learning and Skills Development Agency Conference at Cambridge*. pp. 5-7.

Holmes, B. & Gardner, J. (2006) *E-learning: Concepts and practice.* london: Sage.

Houston, S. (2001) 'Beyond social constructionism: Critical realism and social work'. *British Journal of Social Work*, 31 (6), pp. 845-861.

Hung, H.-T. (2017) 'Language teaching and technology forum the integration of a student response system in flipped classrooms'.

Hunsu, N. J., Adesope, O. & Bayly, D. J. (2016) 'A meta-analysis of the effects of audience response systems (clicker-based technologies) on cognition and affect'. *Computers & Education*, 94 pp. 102-119.

Issroff, K. & Scanlon, E. (2001) 'Case studies revisited, What can Activity Theory Offer', Institute of Educational Technology, T.O.U. (ed. *Proceedings of First Euro-CSCL Conference, Maastricht [cited]*. Higher Education Research and Development Unit, University College London. 2001.

Higher Education Research and Development Unit, University College London.

Issroff, K. & Scanlon, E. (2002) 'Activity theory and enhancing learning: using technology in Higher Education'. *Journal of computer assisted Learning*, 18 (1), pp. 6777-6783.

Jackson, M. H. & Trees, A. R. (2003) 'Clicker implementation and assessment', [Online]. Available at: www. colorado. edu/ftep/technology/FTEPMichele% 20Jack. pdf (Accessed: 22 May 2016).

Johnson, P. & Duberley, J. (2000) *Understanding management research: An introduction to epistemology.* London: Sage.

Johnson, S. (1995) 'Will our research hold up under scrutiny?'. *Journal of STEM Teacher Education*, 32 (3),

Johnson, T. & Meckelborg, A. (2009) 'Student response systems: a cure for lecturalgia?'.

Revista de Informática Aplicada, 5 (1),

Jonassen, D. & Land, S. (2012) *Theoretical foundations of learning environments.* 2 edn. NEW York, The USA Routledge.

Jonassen, D. H. (1994) 'Thinking Technology: Toward a Constructivist Design Model'.

Educational technology, 34 (4), pp. 34-37.

Jonassen, D. H. & Rohrer-Murphy, L. (1999) 'Activity theory as a framework for designing constructivist learning environments'. *Educational Technology Research and*

Development, 47 (1), pp. 61-79.

Jones, C., Dirckinck – Holmfeld, L. & Lindström, B. (2006) 'A relational, indirect, meso-level approach to CSCL design in the next decade'. *International Journal of Computer-Supported Collaborative Learning*, 1 (1), pp. 35-56.

Judson, E. & Sawada, D. (2006) 'Audience response systems: Insipid contrivances or inspiring tools'. *Audience response systems in higher education: Applications and cases*, pp. 26-39.

Kahn, P., Qualter, A. & Young, R. (2012) 'Structure and agency in learning: A critical realist theory of the development of capacity to reflect on academic practice'. *Higher Education Research & Development*, 31 (6), pp. 859-871.

Kaleta, R. & Joosten, T. (2007) 'Student response systems: A University of Wisconsin system study of clickers'. *Educause Center for Applied Research Research Bulletin*, 10 (1), pp. 12.

Kao (2010a) 'EXAMINING SECOND LANGUAGE LEARNING: TAKING A'. *Arecls*, 7 pp. 113-131.

Kao, P. (2010b) 'EXAMINING SECOND LANGUAGE LEARNING: TAKING A'. *Arecls*, 7 pp. 113-131.

Kaptelinin, V. & Nardi, B. A. (1997) 'Activity theory: basic concepts and applications', *CHI'97 Extended Abstracts on Human Factors in Computing Systems*. ACM, pp. 158-159.

Karagiorgi, Y. & Symeou, L. (2005) 'Translating Constructivism into Instructional Design: Potential and Limitations'. *Educational Technology & Society*, 8 (1), pp. 17-27.

Kay, J., Meyer, B. J., Wagoner, D. & Ferguson, L. (2006) 'Technology affordances: the "real story" in research with K – 12 and undergraduate learners'. *British Journal of Educational Technology*, 37 (2), pp. 191-209.

Kay, R. H. & LeSage, A. (2010) 'A strategic assessment of audience response systems used in higher education'. *Australasian Journal of Educational Technology*, 25 (2),

Kelley, P. & Maushak, N. J. (2004) 'Teaching online: Hints from the trenches'. *Distance Learning*, 1 (4), pp. 7.

Kelly, P. (2014) 'Intercultural comparative research: rethinking insider and outsider perspectives'. *Oxford Review of Education*, 40 (2), pp. 246-265.

Kennedy, G. E. & Cutts, Q. I. (2005) 'The association between students' use of an electronic voting system and their learning outcomes'. *Journal of computer assisted Learning*, 21 (4), pp. 260-268.

Kennewell, S., Beauchamp, G., Jones, S., Norman, N., Parkinson, J., Tanner, H., Thomas, G. & Morgan, A. (2007) 'The use of ICT to improve learning and attainment through interactive teaching'. Cardiff Metropolitan University. 2016. [Online]. Available at: https://repository.cardiffmet.ac.uk/dspace/handle/10369/5864 (Accessed: 12 Feb).

Kheir Abadi, M. & Alsop, G. (2011) 'Studying the learning of programming using grounded theory to support activity theory'. *ALT's Open Access Journal*, 2011

King, D. B. & Joshi, S. (2008) 'Gender differences in the use and effectiveness of personal response devices'. *Journal of Science Education and Technology*, 17 (6), pp. 544-552.

King Khalid University (2011) 'For the first time Use of Electronic Voting System'. [Online]. Available at: http://elearning.kku.edu.sa/en/node/11/1526 (Accessed: 29 July 2015).

Klemenčič, M. (2012) 'The changing conceptions of student participation in HE governance in

the EHEA', *European Higher Education at the Crossroads.* Springer, pp. 631-653.

Knight, J. K., Wise, S. B. & Sieke, S. (2016) 'Group Random Call Can Positively Affect Student In-Class Clicker Discussions'. *CBE-Life Sciences Education*, 15 (4), pp. ar56.

Kozulin, A. (2001) *Psychological tools: A sociocultural approach to education.* London: Harvard University Press.

Kuutti, K. (1996) 'Activity theory as a potential framework for human-computer interaction research'. *Context and consciousness: Activity theory and human-computer interaction*, pp. 17-44.

Lantz, M. E. (2010) 'The use of 'clickers' in the classroom: Teaching innovation or merely an amusing novelty?'. *Computers in Human Behavior*, 26 (4), pp. 556-561.

Laufgraben, J. L. & Shapiro, N. S. (2004) *Sustaining and improving learning communities.* San Francisco, USA: Jossey & Bass.

Lave, J. & Wenger, E. (1991) *Situated learning: Legitimate peripheral participation.* Cambridge university press.

Laxman, K. (2011) 'A study on the adoption of clickers in higher education'. *Australasian Journal of Educational Technology*, 27 (8), pp. 1291-1303.

Lee, K. R. (2002) 'Impacts of Information Technology on Society in the new Century'. AWS. [Online]. Available at: https://s3.amazonaws.com/academia.edu.documents/44515877/Impacts_of_Information_Tec hnology1.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1539689045&Signature=k0CPTBzz2DExYMI2and0WsCD%2FVk%3D&response-content-disposition=inline%3B%20filename%3DImpacts_of_Information_Technology_on_Soc.pdf (Accessed: 11 Dec).

Lekena, L. & Bayaga, A. (2012) 'Quality assurance in education: Student evaluation of teaching (SET)'. *International Journal of Educational Sciences*, 4 (3), pp. 271-274.

Leont'ev (1977) *Dialectical logic: Essays on its history and theory.* India Aakar Books.

Leontev, A. (1978) 'Activity, Consciousness, and Personality'. [Online]. Available at: https://www.marxists.org/archive/leontev/works/1978/index.htm (Accessed: 13 Sept).

Leontiev (1979) *The Problem of Activity in psychology* ed. (ED.), I.J.V.W., The concept of Activity in Soviet Psychology Armonk, NY: Sharpe.

Lincoln, Y. S. & Guba, E. G. (1985) *Naturalistic inquiry.* vol. 75. USA: Sage.

Liu, X. (2004) 'Socio-Cultural Context for Online Learning: A Case Study Viewed from Activity Theory Perspective'. *Association for Educational Communications and Technology*,

Liu, Y. (2008) 'Improving student learning by clicking', *Society for Information Technology & Teacher Education International Conference*. pp. 2089-2092.

Losch, A. (2009) 'On the origins of critical realism'. *Theology and Science*, 7 (1), pp. 85-106.

Lymn, J. S. & Mostyn, A. (2010) 'Audience response technology: Engaging and empowering non-medical prescribing students in pharmacology learning'. *BMC medical education*, 10 (1), pp. 73.

MacIntosh, J. A. (1993) 'Focus groups in distance nursing education'. *Journal of Advanced*

Nursing, 18 (12), pp. 1981-1985.

Mareno, N., Bremner, M. & Emerson, C. (2010) *The use of audience response systems in nursing education: best practice guidelines.* DigitalCommons@ Kennesaw State University.

Martyn, M. (2007) 'Clickers in the classroom: An active learning approach'. *Educause quarterly*, 30 (2), pp. 71.

Masikunas, G., Panayiotidis, A. & Burke, L. (2007) 'The Use of Electronic Voting Systems in Lectures within Business and Marketing: A Case Study of Their Impact on Student Learning'. *ALT-J: research in learning technology*, 15 (1), pp. 3-20.

Maxwell, J. A. (2012) *A realist approach for qualitative research.* Los Angeles Sage.

Mayer, R. E., Stull, A., DeLeeuw, K., Almeroth, K., Bimber, B., Chun, D., Bulger, M., Campbell, J., Knight, A. & Zhang, H. (2009) 'Clickers in college classrooms: Fostering learning with questioning methods in large lecture classes'. *Contemporary Educational Psychology*, 34 (1), pp. 51-57.

McCabe, M. & Lucas, I. (2003) 'Teaching with CAA in an Interactive Classroom', *CAA Conference Proceedings. Loughborough: Loughborough University*.

McKnight, K., O'Malley, K., Ruzic, R., Horsley, M. K., Franey, J. J. & Bassett, K. (2016) 'Teaching in a digital age: How educators use technology to improve student learning'. *Journal of Research on Technology in Education*, 48 (3), pp. 194-211.

McLaughlin, K. & Mandin, H. (2001) 'A schematic approach to diagnosing and resolving lecturalgia'. *Medical education*, 35 (12), pp. 1135-1142.

Meedzan, N. & Fisher, K. (2009) 'Clickers in nursing education: An active learning tool in the classroom'. *Online Journal of Nursing Informatics (OJNI)*, 13 (2), pp. 1-19.

Mertens, D. M. (2014) *Research and Evaluation in Education and Psychology: Integrating Diversity With Quantitative, Qualitative, and Mixed Methods: Integrating* ed. Edition, t., The USA: Sage Publications.

Milrad, M. (2003) *Mobile Learning: Challenges, perspectives and reality.* na.

Ministry of Education (2014) *National Project for sterategy for Learning Development in Saudi Arabia* Riydh Minsitry of Educatoin. Available at: http://www.tatweer.edu.sa/sites/default/files/%D8%A7%D9%84%D8%A5%D8%B3%D8%AA%D8%B1%D8%A7%D8%AA%D9%8A%D8%AC%D9%8A%D8%A9%20%D8%A7%D9%84%D9%88%D8%B7%D9%86%D9%8A%D8%A9%20%D9%84%D8%AA%D8%B7%D9%88%D9%8A%D8%B1%20%D8%A7%D9%84%D8%AA%D8%B9%D9%84%D9%8A%D9%85%20%D8%A7%D9%84%D8%B9% D8%A7%D9%85.pdf.

Mitra, S. (2003) 'Minimally invasive education: a progress report on the "hole – in – the – wall" experiments'. *British journal of educational technology*, 34 (3), pp. 367-371.

Moredich, C. & Moore, E. (2007) 'Engaging students through the use of classroom response systems'. *Nurse Educator*, 32 (3), pp. 113-116.

Morgan, D. L. (1997) *The focus group guidebook.* vol. 1. California, USA: Sage publications.

Morling, B., McAuliffe, M., Cohen, L. & DiLorenzo, T. M. (2008) 'Efficacy of personal response systems ("clickers") in large, introductory psychology classes'. *Teaching of Psychology*, 35 (1), pp. 45-50.

Morse, J. M. & Field, P.-A. (1995) *Qualitative research methods for health professionals.* 2d edition edn. london:

Muir, J. (2009) 'Student attendance: Is it important, and what do students think?'. *Transactions*, 6 (2), pp. 50-69.

Mula, J. M. & Kavanagh, M. (2009) 'Click go the students, click-click-click: The efficacy of a student response system for engaging students to improve feedback and performance'. *e-Journal of Business Education and Scholarship of Teaching*, 3 (1), pp. 1-17.

Mumtaz, S. (2000) 'Factors affecting teachers' use of information and communications technology: a review of the literature'. *Journal of information technology for teacher education*, 9 (3), pp. 319-342.

Naidoo*, R. & Jamieson, I. (2005) 'Empowering participants or corroding learning? Towards a research agenda on the impact of student consumerism in higher education'. *Journal of Education Policy*, 20 (3), pp. 267-281.

Nardi, B. A. (1996) 'Activity theory and human-computer interaction'. *Context and consciousness: Activity theory and human-computer interaction*, pp. 7-16.

Neubert, S. (2003) 'Some perspectives of interactive constructivism on the Theory of Education'. University of Cologne. [Online]. Available at: https://www.hf.uni-koeln.de/data/dewey/File/Neubert_Introduction.pdf (Accessed: 15 Nov).

Nicol, D. J. & Boyle, J. T. (2003) 'Peer instruction versus class-wide discussion in large classes: a comparison of two interaction methods in the wired classroom'. *Studies in Higher Education*, 28 (4), pp. 457-473.

Nosek, T., Wang, W., Medvedev, I., Wile, M. & O'Brien, T. (2006) 'Use of a computerized audience response system in medical student teaching: Its effect on active learning and exam performance', *World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education*. pp. 2245-2250.

Nunez, I. (2015) 'A Dialogical Relationship with Cultural -Historical Activity Theory: A R ealist Prespective', in David Scott, E.H. (ed.) *The SAGE Handbook of Learning.* London: SAGE, pp. 62 - 68.

Nye, B. D. & Silverman, B. G. (2012) 'Affordance', *Encyclopedia of the Sciences of Learning.*
Springer, pp. 179-183.

ODonoghue, M., Jardine, R. & Rubner, G. (2010) 'Developing a hierarchy of clicker use for teaching and learning from models of dialogue analysis', *World Conference on Educational Multimedia, Hypermedia and Telecommunications*. pp. 2105-2114.

Oliver, M. & Harvey, J. (2002) 'What does 'impact' mean in the evaluation of learning technology?'. *Journal of Educational Technology & Society*, 5 (3), pp. 18-26.

Oluwole, D. A. (2008) 'The impact of mother tongue on students' achievement in English language in junior secondary certificate examination in western Nigeria'. *Journal of Social Science*, 17 (1), pp. 41-49.

Papalia, D., Olds, S & Feldman, R (2011) *A child's world: infancy through adolescence.* 11th edn. Boston: McGraw-Hill Higher Education.

Park, S. Y. (2009) 'An analysis of the technology acceptance model in understanding university students' behavioral intention to use e-learning'. *Journal of Educational Technology & Society*, 12 (3), pp. 150.

Paschal, C. B. (2002) 'Formative assessment in physiology teaching using a wireless classroom communication system'. *Advances in Physiology Education*, 26 (4), pp. 299-308.

Patry, M. (2009) 'Clickers in large classes: From student perceptions towards an understanding of best practices'. *International Journal for the Scholarship of Teaching and Learning*, 3 (2), pp. 17.

Pelton, T., Francis, L. & Epp, B. (2009) 'Clickers supporting teaching, teacher education, educational research and teacher development', *Society for Information Technology & Teacher Education International Conference*. pp. 1065-1070.

Pelton, T. & Francis Pelton, L. (2008) 'Technology outreach workshops: Helping teachers to climb over the technology threshold by engaging their classes', *Society for Information Technology & Teacher Education International Conference*. pp. 4273-4278.

Plaisant, C. & Shneiderman, B. (2005) 'Show me! Guidelines for producing recorded demonstrations', *Visual Languages and Human-Centric Computing, 2005 IEEE Symposium on*. IEEE, pp. 171-178.

Ponterotto, J. G. (2005) 'Qualitative research in counseling psychology: A primer on research paradigms and philosophy of science'. *Journal of counseling psychology*, 52 (2), pp. 126.

Postholm, M. B. (2008) 'Cultural historical activity theory and Dewey's idea-based social constructivism: Consequences for Educational Research'. *Critical Social Studies*, 1 pp. 37-48.

Price, E., De Leone, C. & Lasry (2012) 'Comparing Educational Tools Using Activity Theory: Clickers and Flashcards Documents'. 3 December 2012. [Online]. Available at: http://webcache.googleusercontent.com/search?q=cache:u-luUINLUuoJ:www.physicstogo.org/document/ServeFile.cfm%3FID%3D10469%26DocID%3D192 9+&cd=5&hl=en&ct=clnk&gl=uk (Accessed: 12 August).

Pring, R. (2000) 'The 'false dualism' of educational research'. *Journal of Philosophy of Education*, 34 (2), pp. 247-260.

Puentedura, R. (2010) 'SAMR and TPCK: Intro to advanced practice'. *Retrieved February*, 12 pp. 2013.

Radnor, H. (2001) 'Researching your professional practice'. *Doing interpretive research. Buckingham: Open University Press*,

Ramasubramanian, P. (2012) 'Six Sigma in educational institutions'. *International Journal of Engineering Practical Research*,

Ramey, H. L. & Grubb, S. (2009) 'Modernism, postmodernism and (evidence-based) practice'.
Contemporary family therapy, 31 (2), pp. 75-86.

Rana, N. P. & Dwivedi, Y. K. (2016) 'Using clickers in a large business class: Examining use behavior and satisfaction'. *Journal of Marketing Education*, 38 (1), pp. 47-64.

Raskin, J. D. (2008) 'The evolution of constructivism'. *Journal of constructivist psychology*, 21 (1), pp. 1-24.

Reay, N. W., Bao, L., Li, P., Warnakulasooriya, R. & Baugh, G. (2005) 'Toward the effective use of voting machines in physics lectures'. *American Journal of Physics*, 73 (6), pp. 554-558.

Retkute, R. (2009) 'Exploring technology-based continuous assessment via Electronic Voting Systems in mathematics and statistics'. *MSOR Connections*, 9 (1), pp. 24-28.

Riege, A. M. (2003) 'Validity and reliability tests in case study research: a literature review with "hands-on" applications for each research phase'. *Qualitative market research: An international journal*, 6 (2), pp. 75-86.

Rienties, B., Brouwer, N. & Lygo-Baker, S. (2013) 'The effects of online professional development on higher education teachers' beliefs and intentions towards learning facilitation and technology'. *Teaching and teacher education*, 29 pp. 122-131.

Rivers, C., Calic, J. & Tan, A. (2009) 'Combining activity theory and grounded theory for the design of collaborative interfaces', *International Conference on Human Centered Design*. Springer, pp. 312-321.

Robinson, C. & King, S. (2009) 'Introducing electronic voting systems into the teaching of mathematics'. *MSOR Connections*, 9 (1), pp. 29-33.

Robson, C. (1993) *Real world research: A resource for social scientists and practitioners-researchers.* Massachusetts: Blackwell Pushers:

Rodriguez, H. (1998) 'Activity theory and cognitive sciences'. *KTH Nada, Stockholm University (19 April 2005),* Stockholm University [Online]. Available at: http://www.nada.kth.se/~henrry/papers/ActivityTheory.html (Accessed: 14 October).

Rodriguez, L. A. & Shepard, M. (2013) 'Adult English Language Learners' Perceptions of Audience Response Systems (Clickers) as Communication Aides: AQ – Methodology Study'. *TESOL Journal*, 4 (1), pp. 182-193.

Roselli, R. J. & Brophy, S. P. (2002) 'Exploring an electronic polling system for the assessment of student progress in two biomedical engineering courses', *Proceeding of the 2002 American Society for Engineering Education Annual Conference and Exposition*.

Roth, W.-M. & Lee, Y.-J. (2007) '"Vygotsky's neglected legacy": Cultural-historical activity theory'. *Review of educational research*, 77 (2), pp. 186-232.

Roush, C. & Song, L. (2011) 'The Impact of Using Clickers Technology on Classroom Instruction: Students' and Teachers' Perspectives', *Society for Information Technology & Teacher Education International Conference*. pp. 2674-2677.

Rummel, E. (2008) 'Constructing cognition'. *American Scientist*, 96 (1), pp. 80-82.

Russell, G. & Pitt, I. (2004) 'Visions of a wireless future in education technology'. *Journal of issues in Informing Science and Information Technology*, 1 pp. 747-752.

Russell, M. (2008) 'Using an electronic voting system to enhance learning and teaching'. *engineering education*, 3 (2), pp. 58-65.

Ryder, M. (2007) 'What is Actor-Network Theory'. *Colorado University (Denver)*,

Saltmarsh, J. (2008) 'Why Dewey Matters'. *The Good Society*, 17 (2), pp. 63-68.

Sayer, A. (1997) 'Critical realism and the limits to critical social science'. *Journal for the Theory of Social Behaviour*, 27 (4), pp. 473-488.

Scanlon, E. & Issroff, K. (2005) 'Activity theory and higher education: Evaluating learning technologies'. *Journal of computer assisted Learning*, 21 (6), pp. 430-439.

Schayer, M. (1997) 'Piaget and Vygotsky. A necessary marriage for effective education intervention'. *Piaget, Vygotsky and beyond. Future issues for developmental psychology and education*, pp. 36-59.

Scott, D. (2005) 'Critical realism and empirical research methods in education'. *Journal of Philosophy of Education*, 39 (4), pp. 633-646.

Scott, D. (2007) 'Resolving the quantitative–qualitative dilemma: a critical realist approach'. *International Journal of Research & Method in Education*, 30 (1), pp. 3-17.

Seaman, J. (2008) 'Adopting a grounded theory approach to cultural-historical research: Conflicting methodologies or complementary methods?'. *International Journal of Qualitative Methods*, 7 (1), pp. 1-17.

Sharma, M. D., Khachan, J., Chan, B. & O'Byrne, J. (2005) 'An investigation of the effectiveness of electronic classroom communication systems in large lecture classes'. *Australasian Journal of Educational Technology*, 21 (2),

Sharpe, R., Benfield, G., Roberts, G. & Francis, R. (2006) *The undergraduate experience of blended e-learning: a review of UK literature and practice.* Citeseer.

Sharples, M. (2000) 'The design of personal mobile technologies for lifelong learning'. *Computers & Education*, 34 (3), pp. 177-193.

Shneiderman, B., Alavi, M., Norman, K. & Borkowski, E. Y. (1995) 'Windows of opportunity in electronic classrooms'. *Communications of the ACM*, 38 (11), pp. 19-24.

Simpson, V. & Oliver, M. (2007) 'Electronic voting systems for lectures then and now: A comparison of research and practice'. *Australasian Journal of Educational Technology*, 23 (2),

Skinner, B. F. (1974) *Walden two.* Cambridge: Hackett Publishing.

Smith, M. P. (1998) 'The Global City: Whose Social Construct is it Anyway?'. *Urban Affairs Review*, 33 (4), pp. 482-488.

Stagg, A. & Lane, M. (2010) 'Using clickers to support information literacy skills development and instruction in first-year business students'. *Journal of Information Technology Education: Research*, 9 (1), pp. 197-215.

Stein, P., Challman, S. & Brueckner, J. (2006) 'The University of Adelaide student experience of learning and teaching—standard teaching evaluation using audience response technology for pretest reviews in an undergraduate nursing course'. *J Nurs Educ*, 45 (11), pp. 469-473.

Stenhouse, L. (1975) *An introduction to curriculum research and development.* vol. 46. Heinemann London.

Stowell, J. R. (2015) 'Use of clickers vs. mobile devices for classroom polling'. *Computers &*

Education, 82 pp. 329-334.

Stowell, J. R. & Nelson, J. M. (2007) 'Benefits of electronic audience response systems on student participation, learning, and emotion'. *Teaching of psychology*, 34 (4), pp. 253-258.

Strauss, A. & Corbin, J. (1998) 'Basics of qualitative research: Procedures and techniques for developing grounded theory'. *ed: Thousand Oaks, CA: Sage*,

Stuart, S. A., Brown, M. I. & Draper, S. W. (2004) 'Using an electronic voting system in logic lectures: one practitioner's application'. *Journal of computer assisted Learning*, 20 (2), pp. 95-102.

Suchman, E., Uchiyama, K., Smith, R. & Bender, K. (2006) 'Evaluating the impact of a classroom response system in a microbiology course'. *Microbiology Education*, 7 pp. 3.

Sylwester, R. & Cho, J. (1993) 'What Brain Research Says About Paying Attention'. *ASCD Learn Teach and Lead*, 50 (4),

The Ministry of Finance (2015) 'Recent Economic Developments and Highlights of Fiscal Years 1435/1436 (2014) & 1436/1437 (2015)'.[in Riyadh. Available at: https://www.mof.gov.sa/English/DownloadsCenter/Budget/Ministry's%20of%20Finance%20statment%20about%20the%20national%20budget%20for%202015.pdf (Accessed:The Ministry of Finance

Thornton, P. (2011) 'Project Report: To what extent do Personal Response Systems benefit learning and teaching within a Higher Education environment?'. *Worcester Journal of Learning and Teaching*, (6), pp. 1-9.

Trees, A. R. & Jackson, M. H. (2007) 'The learning environment in clicker classrooms: student processes of learning and involvement in large university – level courses using student response systems'. *Learning, Media and Technology*, 32 (1), pp. 21-40.

Trowler, V. (2010) 'Student engagement literature review'. *York: Higher Education Academy*,

Turney, C., Robinson, D., Lee, M. & Soutar, A. (2009) 'Using technology to direct learning in higher education The way forward?'. *Active Learning in Higher Education*, 10 (1), pp. 71-83.

Turuk, M. C. (2008) 'The relevance and implications of Vygotsky's sociocultural theory in the second language classroom'. *ARECLS*, 5 pp. 244-262.

Ültanir, E. (2012) 'An Epistemologic Glance at the Constructivist Approach: Constructivist Learning in Dewey, Piaget, and Montessori'.

Van Daele, T., Frijns, C. & Lievens, J. (2016) 'How do students and lecturers experience the interactive use of handheld technology in large enrolment courses?'. *British Journal of Educational Technology*, 48 (6),

Verenikina, I. (2003) 'Understanding scaffolding and the ZPD in educational research', *Proceedings of the International Education Research Conference* Auckland-Newzland 30 November-3 December 2003. The International Education Research Conference (AARE-NZARE),.

Vygotsky, L. (1978a) 'Mind in society harvard university press'. *Cambridge, MA*,

Vygotsky, L. (1978b) 'Interaction between learning and development'. *Readings on the development of children*, 23 (3), pp. 34-41.

Waite, T. (2005) 'Activity theory'. Indiana University Bloomington. [Online]. Available at:

https://www.ils.indiana.edu/faculty/yrogers/act_theory2/ (Accessed: 14 July).

Walklet, E., Davis, S. K., Farrelly, D. & Muse, K. (2016) 'The Impact of Student Response Systems on the Learning Experience of Undergraduate Psychology Students'. *Psychology Teaching Review*, 22 (1),

Watfa, M. K. & Audi, D. (2017) 'Innovative virtual and collaborative teaching methodologies'. *Behaviour & Information Technology*, pp. 1-11.

Weegar, M. A. & Pacis, D. (2012) 'A Comparison of two theories of learning-behaviorism and constructivism as applied to face-to-face and online learning'. *E-Leader Manila*,

Wheelahan, L. (2007) 'Blending activity theory and critical realism to theorise the relationship between the individual and society and the implications for pedagogy'. *Studies in the Education of Adults*, 39 (2), pp. 183-196.

White-Clark, R., DiCarlo, M. & Gilchriest, S. N. (2008) '" Guide on the side": An instructional approach to meet mathematics standards'. *The High School Journal*, 91 (4), pp. 40-44.

Williams, K. C. & Williams, C. C. (2011) 'Five key ingredients for improving student motivation'.
Research in Higher Education Journal, 12 (1), pp. 1-23.

Willis, J. (2005) 'Attention: To Have and to Hold Add the Science of Learning to the Art of Teaching to Enrich Classroom Instruction'. *Journal of the National Council of English Teachers*,

Wilson, T. D. (2006) 'A re-examination of information seeking behaviour in the context of activity theory'.[*Information Research*. 11, 1. Available at: http://www.informationr.net/ir/11-4/paper260.html

Wit, E. (2003) 'Who wants to be… The use of a personal response system in statistics teaching'.
MSOR Connections, 3 (2), pp. 14-20.

Wozney, L., Venkatesh, V. & Abrami, P. (2006) 'Implementing computer technologies: Teachers' perceptions and practices'. *Journal of Technology and teacher education*, 14 (1), pp. 173-207.

Yager, R. E. (1991) 'The constructivist learning model'. *The science teacher*, 58 (6), pp. 52.

Yamagata-Lynch, L. C. & Haudenschild, M. (2006) 'Using Activity Theory to Identify Contradictions and Tensions in Teacher Professional Development'. *Online Submission*,

Yamagata-Lynch, L. C. & Smaldino, S. (2007) 'Using activity theory to evaluate and improve K-12 school and university partnerships'. *Evaluation and program planning*, 30 (4), pp. 364-380.

Yin, R. (1994) 'Case study research: Design and methods. Beverly Hills'.[in CA: Sage publishing. (Accessed: Yin, R.

Yoder, J. D. & Hochevar, C. M. (2005) 'Encouraging active learning can improve students' performance on examinations'. *Teaching of Psychology*, 32 (2), pp. 91-95.

Young, M. (2001) 'Contextualising a new approach to learning: Some comments on Yrjö Engeström's theory of expansive learning'. *Journal of Education and Work*, 14 (1),

Zhonggen, Y. & Liu, C. (2014) 'The influence of clickers use on metacognition and learning

outcomes in College English Classroom'. *International Journal of Information and Communication Technology Education (IJICTE)*, 10 (2), pp. 50-61.

Zhu, E. (2007) 'Teaching with clickers'. *Center for research on learning and teaching occasional papers*, 22 pp. 1-8.

Zittoun, T. & Gillespie, A. (2015) 'Internalization: How culture becomes mind'. *Culture & Psychology*, 21 (4), pp. 477-491.

Appendices

Appendix 1: Interview questions for lecturer

Interview questions for lecturers:

1- How long have you been teaching in Higher Education?
2- (a) Do you use technology for lecturing?
   (b) Which technology do you use for lecturing?
   (c) How do you find technology?
3- (a) Do you find the Personal Response System technology easy to use?
   (b) Are there any ways you can think of to make it easier?
4- Do you spend more effort and time prepare for lecture with the Personal Response System compared to a traditional lecturer?
5- What do you think are the strengths and the disadvantages of using PRS?
6- Does using PRS help you to improve the way you lecture? If so, how?
7- Does using PRS change the way you communicate with students? If so, how?
8- Has using PRS given more opportunities for students to participate and discuss their answers? If so, how?
9- Does using PRS help you to achieve your objectives as a lecturer? If so, how?
10- Do you experience a lack of control when you are using this technology? If so, please explain.
11- Do you think the way students act in the lecture has changed since you have started using this technology?
12- Does using PRS help you to measure students' understanding and identify the concepts are not being understood? If so, how?
13- Does using PRS help you to assess your teaching? If so, how?
14- Is there anything you would like to tell me about PRS?

Interview questions for lecturers in Arabic

1) اسئلة عامة

- ماهو دورك الوظيفي ؟.....
- كم طول المدة التي عملت بها بالتدريس؟.....
- ماهو مادى ارتياحك لاستخدام التكنولوجيا الجديده؟.....
- ماهو مدى استخدامك للتكنولوجيا الجديدة في تدريسك؟.....
- كم مدة استخدامك لجهاز التصويت الالكتروني؟.....
- ماهو مدى استخدامك لجهاز التصويت الالكتروني في التدريس؟.....
- ماهي وجة نظرك من جهة المزايا و العيوب في استخدام جهاز التصويت الالكتروني في التدريس؟.....
- هل تعطى اي تدريب او تحضر اي دورات في استخدام التكنولوجيا الجديدة؟.....

2) اسئلة عن استخدام جهاز التصويت الالكتروني و الاستخدام التربوى له:

- في اي المحاظرات يتم استخدام جهاز التصويت الالكتروني؟.....
- في اي مستوي غالبا يتم استخدام جهاز التصويت الالكتروني في التدريس؟.....
- مالدافع لك لاستخدام جهاز التصويت الالكتروني في تدريسك؟.....
- كيف يتم تحديد الاسئلة خلال استخدام جهاز التصويت الالكتروني في التدريس؟.....
- ماهي اهدافك و معايير استخدام الالسئلة خلال التدريس باستخدام جهاز التصويت الالكتروني؟.....
- متى يتم استخدام جهاز التصويت الالكتروني (بداية او خلال او نهاية المحاظره.....
- هل من المهم استخدام الاسئلة المشوشة او الغير الواضحة واستخدام صح او خطا؟ اشرح اجابت .....
- اي نمط من التدريس تفضل عند استخدام جهاز التصويت الالكتروني؟.....
- هل تستخدم جهاز التصويت الالكتروني لتقييم مستوى الطلاب خلال الفصل الدراسي؟.....
- هل تستخدم جهاز التصويت الالكتروني لتقييم مستوى الطلاب بنهاية الفصل الدراسي؟.....
- هل تحدد درجات لاستخدام جهاز التصويت الالكتروني في المحاظرة؟.....
- ماهو شعورك لاجابات الطلاب حين يتم استخدام جهاز التصويت الالكتروني في التدريس؟.....

Appendix 2: Group interview questions for students

Group interview for students:

1- Do you use technology to help you learn?
2- Which technology do you find helpful in your learning? 3- Are there any technologies that are not helpful?
4- How do you find using PRS as tool for learning?
5- Does using PRS change the way you act in the classroom?
6- Does using PRS change the way your lecturer acts in the lecture?
7- If there are any changes to their behaviour, how does that help you to achieve you education objectives?
8- How does PRS change the communication between you and your fellow students, and between you and the lecturer?
9- (a) Do you think is it possible to use PRS in all your subjects? Why?
(b) Would it be different using the PRS in different subjects? Why?
10- Does using PRS help you to measure your understanding and correct misunderstandings?
11- Are there any disadvantages PRS has brought to the education environment? Why do you think so?
12- Is there anything you would like to tell me about PRS?

Group interview questions for student in Arabic

المقابلات مع المجموعات للطلاب

هل تستخدم التكنولوجيا للمساهمة في تحسين تعلمك ؟

اي نوع من التكنلوجيا يعتبر مفيد لك ؟

هل هناك تكنولوجيا غير مفيده لك ؟

ما هو انطباعك عن استخدام جهاز التصويت الشخصي كأداة للتعلم؟

هل استخدام جهاز التصويت الشخصي غير تعاملك أو أدائك داخل الفصل ؟

هل استخدام جهاز التصويت الشخصي غير أداء المعلم داخل الفصل؟

إذا كان هناك تغيير كيف أدى ذلك إلى تحقيق هدفك من التعلم ؟ هل

أدى جهاز التصويت الشخصي إلى تغيير التواصل بينك و بين الطلاب

الاخرين؟ بينك و بين المعلم؟

هل تعتقد يمكن استخدام جهاز التصويت الشخصي في كل المواد؟ لماذا؟

هل استخدام جهاز التصويت الشخصي يختلف من مادة إلى مادة ؟ لماذا؟

هل استخدام التصويت الشخصي يساعدك على قياس مدى فهمك للمادة؟

هل هناك فرق في استخدام الجهاز بشكل شخصي أو مع مجموعة؟ لماذا ؟

هل هناك عيوب و مزايا من استخدام جهاز التصويت الإلكتروني؟

هل هناك ما تود إضافته بخصوص استخدام جهاز التصويت الالكتروني؟

Appendix 3: Questionnaire for students

Questionnaire for Students
Which year do you study in? ……..

Pleas choose the suitable answer for you

Items	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The immediate feedback on the bar graph helps me measure my understanding					
Using PRS technology is an effective learning experience					
Using PRS technology motivates me to learn the course material					
Bar chart summary of student responses to questions					
Seeing how the rest of the class voted helps clarify difficult concepts					
Being part of the group providing the right answer on the bar graph is encouraging					
It is helpful to see if the majority of the class members understand a concept					
Answering some questions independently helped me monitor my understanding					
I am more likely to participate with clickers than with a show of hands					
Peer discussions help to clarify difficult concepts					
Peer discussions help me get more answers correct					
Peer discussions help me remember information					
Peer explanations of the correct response					
Explaining concepts to peers helps me understand complex material					
Answering questions with clickers reduces my fear of ridicule					
I appreciate that my vote is anonymous					

- Has using PRS changed your way of learning? If so, how?

- Does this happens all the time or sometimes? Explain your response?

- Has the use of PRS changed the nature of the relationship between you and the lecturer? If so, how?

- Has using PRS changed the nature of the relationship between you and other students? If so, how?

- How has using PRS changed your role as Lerner?

- Has using PRS changed the nature of interaction in the classroom? If so, how?

- Have the rules of PRS technology changed the way you act in the classroom? If so, how?

- Have your learning goals changed since PRS technology was

The questionnaire for student in Arabic

ماهي السنة الدراسية التي تدرس بها...

مامدى سهولة استخدام التكنولوجيا الجديدة بالنسبة لك؟

غير سهلةنوعا ما سهلة

محايد سهلة االستخدام

االسئلة	بشدة اتفق	اتفق	محايد	اتفق ال	بشدة ال اتفق
اسئلة التعلم					
1- االلكتروني احصل على تقييم بأستاخدام جهاز التصويت لتهم لموضوع المحاظرة					
2-استخدام جهاز التصويت االلكتروني ساعدني التعلم الكثر بدل من اسلوب المحاضرات بدونه					
3- اسئلة جهاز التصويت االلكتروني دافع لي للمشاركة في المحاظرة					
4- االلكتروني ساعدتني لقياس مدى تعلمي من المجاظرة اسئلة جهاز التصويت					
5- سوف اكون الكثر جدية في اذا كان التصويت يتم تقييمه االجابة					
6- التصويت االلكتروني اذا طلب انا قادر على تبرير اجابتي من ذلك امام الطالب					
7- في المحاظرة مع جهاز انا اتذكر المعلومات المذكورة التصويت االلكتروني الكثر من المحاظرة بدونه					
اسئلة السلوك					
1- التصويت االلكتروني بعناية انا اختار اجاباتي السئلة					
2-انا اعطي اهتمام الجاباتي اذا صحيحة او خاطئه					
3- احاول معرفة سبب الخطاء في عندما تكون اجاباتي خاطئة االجابة					

باستخدام النصوبت االلكتروني واسأل االسؤله في المحاضره 4- عادئنا من السهل علي ان انتقلم					
االلكتروني في الفصل ازداد 5- منذ البدء في استخدام النصوبت حضوري للفصل					

- ا اي نوع من االسئلة تفضل االجابة عليها) اسئلة متعددة االختيارات -اسئلة مفتوحة(؟ لماذا

.....
.....

- اعط امثلة للطرق التي اضافها التعليم االلكتروني لتعليمك

.....
.....

- كيف يمكن استخدام التصويت االلكتروني من المنع او الحد من تلميك.

.....
.....

Appendix 4: Interview consent form for lecturers

Study Title: Use of Personal Response Systems for learning development at King Khalid University

Project Details

The purpose of this project is to evaluate and understand the use of Personal Response System (PRS) technology in Higher Education. King Khalid University is being used as a case study for this research. The study will collect data from lecturers and students over about three months. Lecturers who use PRS technology will be interviewed about their use of this technology. The study will look at the advantages and disadvantages of using PRS technology and whether it has changed the relationship between lecturers and students. Results will be used to improve the use of PRS technology and use of technology in general in Higher Education. The project will not affect the teaching process in any way.

Confidentiality

Interview tapes and transcripts will be held in confidence. They will not be used for purposes other than those described above, and third parties will not be allowed to access to them, except the research supervision team and the external examiner to assess the data (except as may be required by law). If you request it, you will be supplied with a copy of *your* interview transcript so that you can comment on and edit it as you see fit (please provide your e-mail address below). Your data will be protected in accordance with the Data Protection Act. Data will be used for research purposes only. There is no known risk of participating in this study. You can decline to answer any question, or to stop the interview at any time.

Anonymity

Interview data will be held and used anonymously, with no mention of your name, but, in the case of lecturers, with reference to the group of which you are a member. You may withdraw from this study at any time without penalty before the analysis of the data begins.

Researcher Contact Details:

For further information about the research or about your interview data, please contact: Bandar Alzahrani, the School of Education, Plymouth University, Devon UK. E-mail bandar.alzahrani@plymouth.ac.uk

Consent:

I voluntarily agree to participate and to the use of my data for the purposes specified above. I can withdraw consent at any time by contacting the interviewers.

TICK HERE: □ **DATE**…….....

Note: Your contact information is kept separately from your interview data

Name of interviewee: .....

Signature: .....

E-mail/phone: .....

Appendix 5: Participant consent form for students

Title: *Use of Personal Response Systems for learning development at King Khalid University*

The benefits and risks of participation

Your participation is important to evaluate the use of this technology. Your participation will improve the way this technology is used, helping it become more beneficial. Your participation is completely voluntary. You may withdraw from this study at any time without penalty before starting analyzing the data. Furthermore, there are no known risks of participating in this project.

Confidentiality

All information obtained in this study, whether from questionnaires or focus group interviews, will be kept strictly confidential by the researcher. The questionnaire will be anonymous and your name will not be associated with it. Focus groups will not record the identities of students. The researcher will note only opinions and perspectives on PRS technology. Data will be used for research purposes only.

All participants will be asked not to disclose anything said in focus groups. By agreeing to participate, you agree not to disclose to others outside your focus group anything said in discussion. All identifying information will be removed from the collected materials, and all hard copies and electronic copies of materials will be kept in a safe place.

Researcher Contact Details:

For further information about the research or about your interview data, please contact: Bandar Alzahrani, the School of Education, Plymouth University, Devon UK. E-mail bandar.alzahrani@plymouth.ac.uk

Consent:

I wish to participate in the above named project. I have read the participant information sheet and understand the following:

1. I am free to withdraw at any time.

2. All information I provide will be dealt with confidentially.

3. I agree that the researcher may contact me.

Name ……..

Signature

……

Date

……

If you have any questions about this study, please contact:

Bandar Alzahrani

E-mail: Bandar.alzahrani@plymouth.ac.uk

Appendix 7: The responses to the questionnaire by students

Questions	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
Strongly agree	0	39	17	20	25	26	17	9	26	26	15	10	15	15	48	41
Agree	76	26	53	38	28	47	29	55	47	35	45	48	49	48	27	25
Neutral	0	9	3	12	19	1	28	7	2	15	8	13	12	11	1	10
Disagree	0	2	3	6	4	2	2	5	1	0	8	5	0	2	0	0
Strongly disagree	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The percentages of the responses for each question:

Percentage	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
Strongly agree	0%	51%	22%	26%	33%	34%	22%	12%	34%	34%	20%	13%	20%	20%	63%	54%
Agree	100%	34%	70%	50%	37%	62%	38%	72%	62%	46%	59%	63%	64%	63%	36%	33%
Neutral	0%	12%	4%	16%	25%	1%	37%	9%	3%	20%	11%	17%	16%	14%	1%	13%
Disagree	0%	3%	4%	8%	5%	3%	3%	7%	1%	0%	11%	7%	0%	3%	0%	0%
Strongly agree	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Appendix 8: Sample of students' answers to the questions in the questionnaire:

Answers	Number of students	How?
Yes	62	"There are possibilities to talk to other students and share knowledge" "I can ask other students when I cannot understand a concept described by the lecturer" "During the discussion time I can understand more from other students and I can ask questions" "I gain more confidence when I explain concepts to other students" "I feel I can express my understanding to other student and that helped me measure my understanding"
No	17	"I don't feel so, because some students do not prefer to share their answers with me" "Not all the time, because lecturers does not allow us to discuss our answers sometimes"

Has using PRS changed your way of learning? If so, how?

Answers	Number of students	How?
Yes	55	"Ability to engage in the learning activity by answering questions or sharing knowledge with other students and being active during the lecture" "Ability by construct understanding through answering PRS questions during the lecture and sharing knowledge with other students"
No	12	"I feel the I gain more knowledge from the lecturer's explanation and trying to memorizing the information" "Some students were not cooperating during the learning activity to share knowledge" "Technical problems disrupted the change in learning" "Some lecturers did not help us adapt to the change in learning style by asking a unclear question, not allowing time to use the system, or not allowing time for discussion"

Appendix 9: Sample of the lecturers' answers

How long have you been teaching in Higher Education institutions?

I have been teaching for around 35 years in the UK, the USA, Nigeria and Saudi Arabia.

Do you use technology for teaching?

Yes, I do use technology for teaching, such as PowerPoint, projector, internet and other technology. However, these technologies make students passive learners, just watching or listening, but with clickers we help them to get active. That will lead to more attentiveness and knowledge retention.

How long have you been using the clickers (PRS)?

I have been using PRS for around 2 years.

Do you find the clickers easy to use and useful?

From my experience it's easy to use and install, however, it was difficult to use at the beginning. The system was a great tool for me to improve my lecturing.

Could you please tell me more about your experience in using this technology?

Yes, I am happy to tell you that. Actually, I was involved in an experiment in using this technology at King Khalid University and that was 2011-2012 – the second semester of that year. I found the clickers interesting and useful. Since then, I have decided to use this technology in my lectures. The reason for this decision is the students do not have any kind of motivation in the lecturers (to participate, ask questions, discuss any difficult concepts or even attend the lectures, because the students attendance is low) especially in my lectures. This technology helps me a lot to get most of the students to participate; this is particularly difficult because the number of students in my class is huge – around 80 students. After using this

technology, I noticed that student attendance had increased, all students in the lectures participated and the consequences are that students pay more attention to the lecture and are more able to answer the questions. There is more interaction between me and the students, and between them as well. This system is beneficial for most of the students because the lecture must be delivered in English, so most of them act as passive learners because they are afraid of making mistakes in front of other students. Therefore, PRS gives them more opportunities to participate and correct any misunderstandings. Nevertheless, a good plan for the lecture must be prepared prior to the lecture with the clickers. The plan must include the number of questions, the time for asking the questions and the quality of the questions. The students will get bored if you keep using the same strategy.

What do you think the advantages and disadvantages of using this technology are?

Obviously, there are many advantages of using this technology: increased interaction, students pay more attention, measuring students' understanding to correct any misunderstandings or to assess my strategy of teaching. It easy to use and install in any room as long as the clicker is compatible with the computer system in that room.

The disadvantages of this technology are the technical problems we have during the lecture. In addition to that we do not have technical support for this technology, so I have to solve all the problems without any support. The clickers can be a distraction for students if I don't plan very well for the lecture and when should I ask the questions. Sometimes, there isn't enough time to use the system or to discuss the results of the questions. Furthermore, we cannot put marks on the students' performance, because the university policy does not allow that. I believe that having quizzes without notice will motivate students to perform better and increase students' attention.

Does using the clickers help you to achieve your objectives?

Yes, it is helps me. I believe students learn more with the clickers and that can be seen through their greater attentiveness, they ask questions more than before, making more effort to choose the right answer by discussing the answers between them. In subjects like physiology students enjoy lectures, but they forget everything as soon as they leave the class. This system will help them to prepare for the class, pay attention and interact during the class, as well as revise new information after the class by discussing that with their colleagues or through self-study. I noticed that students think more deeply about new information and that can be seen through the marks in their exams.

Do you think is it better to use the system with groups or individually?

In my case, it is better to use it individually because most of the students are shy and the number of students in a class is quite big, so using the system individually is more practical than in groups. However, we need to allow time for discussion for each question to get the full benefits of the system.

Do you think the system has changed communication between you and the students and between students themselves?

Yes, more students participate and that allows me to ask any students who participate a question, or he can ask me to clarify any misunderstanding. Moreover, the means of communication between students definitely has changed, since all students engage more in any discussion.

Do you think the clickers help you to achieve your objectives? If so, how?

Yes, I believe so. My main objective in lectures is to help my students understand the concepts, not to cover everything. The students, when using the clickers, are more involved in the lecture. In other words, they are interacting and discussing questions, which will lead to more

understanding, correcting any misunderstandings and getting better marks in the exams. However, in some subjects it might be difficult to achieve the objectives by using the clickers because there is no time for asking questions or discussing the results. In fact, without discussion, students are going to memorise the answers without understanding why they are correct.

Do you experience any loss of control while using the clickers?

No, I don't think so, because I need to plan very well before the lecture, give the students enough time to answer each question and allow them to discuss their answers.

Do you think using the clickers has changed the way students act in class?

Yes, especially shy students become more confident with this technology. Moreover, students pay more attention and become more engaged with the lecture, rather than playing with their phones or chatting. The English language became no barrier for students to participate because they can read the questions, understand their meaning and are more able to answer them. However, using this technology does not help them to improve their English skills.

Appendix 10: Sample of the students' answers for the group interview

Group Interview 2

5 students, ranging in age between 23 and 27 years old.

1- Does using technology help you in your learning?

Student 1: Absolutely, using technology is so helpful. Using the technology changes the traditional lecture atmosphere and we get more interested in attending the lecture.

Student 2: The technology saves time and effort, so I will learn more. For example, using Blackboard saves time and effort, because I can find all the e-resources and contact the lecturer through it.

Student 3: Technology is so helpful. I agree with Student 1, the lectures become more interesting and I focus more in the content when technology is used.

Student 4: Technology is often helpful. However, sometimes technology is not useful because of the lecturers. For example, using PowerPoint in the lecture can be helpful, but if the lecturer is not good at presentations it's not helpful. It can be good if he is good at presentations.

Student 5: Technology is helpful, when I can I use it. For example, using the voting system is helpful because I can use it and participate. However, the other technologies can be helpful but not interesting because I don't know how to use it.

2- Which technologies do you find helpful?

Student 1: Using PowerPoint, YouTube, websites and the voting system. These technologies make me more excited and encouraged to attend lectures.

Student 2: I find YouTube, PowerPoint and the voting system so useful because it makes us concentrate more in the lectures.

Student 3: I like to use websites, the voting system and YouTube.

Student 4: I think YouTube, websites and the voting system are so useful.

Student 5: I find the voting system and Blackboard useful.

3- Are there any technologies that are not helpful?

Student 1: The projector is not helpful because the lecturer's handwriting is not clear. I cannot read and write any notes, therefore, I don't find it helpful.

Student 2: I think all technologies for teaching are helpful. However, using different technologies at once is not helpful because I get distracted and I cannot concentrate on more than one thing.

Student 3: Using the websites during the lectures is not helpful, because they are very detailed and cannot be followed easily in that context. Moreover, some websites are well organized and the structure of others is not clear.

Student 4: No, I don't think there is a technology that is not helpful.

Student 5: I think using PowerPoint is helpful, but it is boring because the lecturer only read the content without asking questions or giving examples.

4- How do you find using PRS as tool for learning?

All students agreed that the PRS is useful and an effective tool for learning.

Student 1: With this system I become more active and motivated to learn more and to answer more questions correctly.

Student 2: The system motivated me to attend the lectures and be a part of the educational operation.

Student 3: I agree the system makes me feel and act as part of the lecture, where I can participate and contribute to this environment. In traditional lectures, I feel I act as receiver for the information from the lecturers.

Students 4: It is a great tool, which allows me to participate and concentrate more in the lectures. Not only that, but we discuss the questions and share the knowledge.

Student 5: I think my English language skill has improved after using this technology. In addition to that, I feel more confident in speaking English because I read and discuss the answer in English and I hear the terms from the lecturer.

5- Does using PRS change the way you act in the classroom?

Student 1: Yes, Instead of sitting and listening to the information, I can now participate and discuss the answers with this technology, allowing me to learn more.

Student 2: I focus more in the lecture than before because I want to make sure all my answers are correct.

Student 3: I become more active, participate more and am more engaged with the lesson.

Student 4: I agree with Student 1. In the traditional lectures we did not have a voice or any action. Now with the voting system, we can participate and ask questions of the lecturers.

Student 5: With the voting system I interact more with other students and from that I can learn more than before. Moreover, I understand the content more than I do in the traditional lecture because I share the information with other students and correct any misunderstandings.

Student 9: The PRS offers flexibility to the way we communicate with a lecturer. I can receive questions from him and I can ask him any questions if I did not understand a specific concept during the lecture. I feel receiving more questions from the lecturer during the lecture has

encouraged me to ask him freely for help. Whereas, in the traditional lecture, that was quite difficult because I used to feel shy. Other students felt similarly and did not usually ask questions.

6- Does using PRS change the way a lecturer acts in the lecture?

Student 1: Yes, the lecturer becomes closer to us because he repeats the answer for any question. If we do not answer any question correctly, he will explain more.

Student 2: He gives more explanation for the difficult points and offers us more time to ask questions if we don't understand the content.

Appendix 11: Example of the students' answers to the questionnaire

Items	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The immediate feedback on the bar graph helps me measure my understanding	√				
Using PRS technology is an effective learning experience	√				
Using PRS technology motivates me to learn the course material		√			
Bar chart summary of student responses to questions	√				
Seeing how the rest of the class voted helps clarify difficult concepts		√			
Being part of the group providing the right answer on the bar graph is encouraging	√				
It is helpful to see if the majority of the class members understand a concept			√		
Answering some questions independently helped me monitor my understanding		√			

Has using PRS changed the way you learn? If so, how?

Yes, the way I learn has changed since we started using the voting system. I become more active since I can participate with this technology and learn from the other students' answers.

Does this happen all the time or sometimes?

It happens almost all the time. However, sometimes my learning does not improve because the questions are not clear or difficult, or when the question is asked is unsuitable.

Has the use of PRS changed the nature of the relationship between you and the lecturer? If so, how?

Yes, I believe so. In the absence of the system there was not an actual relationship between us and the lecturers. The systems offer more opportunities to communicate with the lecturer than before. Moreover, the system helps me to understand the lecturer when he asks questions because he is asking questions in English.

Has using PRS changed the nature of the relationship between you and the other students? If so, how?

Yes, with the PRS system the relationship between me and other students has changed positively. I can discuss the questions and answers with other students and that helps me to correct any misunderstandings.

How has using PRS changed your role as a learner?

My role as a learner has changed because I have become more active. Instead of sitting and listening to the lecturer, I can participate, discuss answers and ask questions for clarification. Moreover, PRS helps the lecturer to measure our understanding and decide to give more explanation or proceed to the next point.

Has using PRS changed the nature of interaction in the classroom? If so, how?

Yes, the nature of interaction has changed, or rather interaction has come out of using the system, because I feel there was no interaction in the old style of lectures.

Have the rules of PRS technology changed the way you act in the classroom? If so, how?

Yes, I think so. The rules of the system encourage me to participate in a positive way. Moreover, I need to think carefully before choosing the answer and ensure that I do not exceed the time limit.

Have your learning goals changed since PRS technology was introduced? If so, how?

Yes, I think so. Generally, in the lectures without PRS my goal is attendance, because it is important, but the content can be accessed through Blackboard. In PRS based lectures, the goals become increasing understanding, competing with other students, asking questions and enjoying learning with the new system. The most important goal for me is passing the exam successfully, which is more likely with the system.

Is there anything you would like to convey mention about PRS?

No thanks.

Appendix 12: Ethics committee approval

RESEARCH WITH PLYMOUTH UNIVERSITY

22 January 2014

CONFIDENTIAL

Bandar Alzahrani

75 The Aspect

140 Queen Street

Cardiff

Dear *Bandar*

Application for Approval by Education Research Ethics Sub-committee

Reference Number: 13/14-24

Application Title: The Use of personal response system at King Khalid University (KKU) in Saudia Arabia for learning development

I am pleased to inform you that the Education Research Ethics Sub-committee has granted approval to you to conduct this research subject to the following amendments that must be approved by your Director of Studies:

- The Director of Studies' contact details (e-mail address) should also be included in the various documents.
- Once it is clearer when the research is taking place, the date for the beginning of analysis should be set. Then, when transcripts are sent out

a time limit can be set as an opt-out feature, for example, “If I have not heard from you before [date] I assume you deem the transcript to be accurate and I can include it in my analysis. If you want to make corrections or if you want to withdraw the data, please let me know before this date.”

- The participants need to know that University policy is to keep data for ten years; they cannot be expected to find that out for themselves.
- If respondents are to have a chance to withdraw their data after they have returned the questionnaire, a mechanism must be in place to allow the questionnaire in question to be identified.
- With regards to withdrawal from the focus group, this is more problematic. Whilst participants can leave the focus group, withdrawing their data afterwards is not possible. It would only work if all the voices could be clearly identified and are not connected in any way to what other members of the group are saying.
- You do not need to include the whole of the University’s ethics policy in your documentation, a hyperlink to where it can be found is sufficient.

Please note that this approval is for three years, after which you will be required to seek extension of existing approval.

Please note that should any MAJOR changes to your research design occur which effect the ethics of procedures involved you must inform the Committee. Please contact Claire Butcher on (01752) 585337 or by email claire.butcher@plymouth.ac.uk

Yours sincerely

Professor Linda la Velle

Chair, Education Research Ethics Sub-committee -

Plymouth Institute of Education

Faculty of Arts and Humanities

Appendix 13: Approval from King Khalid University to conduct the study

KINGDOM OF SAUDI ARABIA
Ministry Of Higher Education
King Khalid University
e-learning Deanship

المملكة العربية السعودية
وزارة التعليم العالي
جامعة الملك خالد
عمادة التعلم الإلكتروني

Plymouth University
Roland Levinsky Building,
Plymouth University,
Drake Circus,
Plymouth PL4 8AA
Phone: 01752 600600

Dear Sir / Madam

I am writing to inform you that Mr Bandar Alzahrani (PhD student at Plymouth University) was granted an approval to conduct his research title "The Use of Personal Response System at King Khalid University (KKU) in Saudi Arabia for learning development" at the King Khaled University in Saudi Arabia. In this regard, we are pleased to offer any support may the researcher need to conduct his research.

Should you require further information please contact me

Yours Sincerely

Abdullah Alwalidi Ph.D
Dean of e-learning
King Khalid University
P.O.Box 960 Abha 61421
Saudi Arabia
Phone: 96672417615

Fax: 96672418115

المرفقات : التاريخ : / / ٣٤ ١٤هـ الرقم : ٦٣/
e-mail: eltc@kku.edu.sa | ٢٤١٨١١٥ : | ٢٤١٧١١٤ : | أبها – ٩٦٠٠ :
elc.kku.edu.sa
عبدالله جهاش

Appendix 14: Publication

Analysing the use of the Personal Response System through the lens of Activity Theory

Abstract

The main purposes of using PRS are to increase interaction, engagement, participation and understanding. Many studies have been conducted to evaluate the use of the PRS and showed an increase in interactivity. However, the learning activity with PRS has not been seen as a joint activity where the learner interacts with different components in the PRS activity to achieve their objectives. The reason behind the lack of viewing the PRS activity as a joint learning activity is an unsystematic approach to studying the use of PRS. This study has selected Activity Theory as lens to evaluate the use of PRS in Higher Education. Activity Theory provides a holistic approach to analyse the use of PRS as learning tool. The study used a case study approach and King Khalid University in Saud Arabia was chosen as a location to conduct the study. The data mainly relied on qualitative methods, for example, interviews, group interviews and a questionnaire. The findings of the study show improvements in learning through the relationships between the components of the activity. For example, relationships between students and lecturers, and between the students themselves. Additionally, PRS technology was a solution for constraints in the traditional lecture, where completing the learning objectives faced difficulties.

Alzahrani, B, (2016). Analysing the use of the Personal Responses System (PRS) through activity theory lenses. In INTED 2016 conference. Valencia, Spain, 7th-9th March 2016,. Valencia, Spain: the international academy of technology, education and development (INTED). P5459 -5468.

Appendix 15: Conferences

- Combining Activity Theory and Grounded Theory to understand the use of Technology in Higher education. ICEEPSY (the International Conference on Education and Educational Psychology) - October 2015 – Istanbul- Turkey.

- Analysing the use of the Personal Responses System (PRS) through activity theory lenses. INTED (10th Annual International Technology, Education and Development Conference)2016 – March 2016 – Valencia- Spain.

- The use of the Personal Response System for Learning Development-IHC and EdD Postgraduate Research Student Conference – April 2015- Plymouth University – UK.

- Postgraduate Research Conference - IHC and Institute of Education – June 2015- Plymouth University – UK.

- Social Sciences Post Graduate Conference- June 2015- Plymouth University- UK.

- Technology & Pedagogy in Practice Conference – October 2015 – organized by Digital ELT- Ireland.

- Cumberland Lodge Conference – August 2015 – London- UK.

Appendix 16: The history of the Personal Responses System

The history of the Personal Responses System (PRS) spans forty years and what is available now has been greatly developed in this time, seeing phases of success and failure along the way (Agbatogun, 2013). The first purpose of introducing PRS to education was to collect feedback (Abrahamson, 2006). It was first used in 1966 at Stanford University and then in 1968 at Cornell University by researchers and educators. The first attempt, at Stanford University, was not successful because of "their primitive-analogue complexity" (Agbatogun, 2013), which meant the PRS was perceived as difficult to use. The second attempt, at Cornell University in 1968, was more successful for teaching and learning. There were attempts in Germany and Japan to use the technology in an education setting around that time, but there is no certainty about the success of these attempts (Abrahamson, 2006).

In 1985, a research group was led by Abrahamson aimed at developing what was called "ClassTalk" (Agbatogun, 2013), in order to improve the learning environment. ClassTalk was a type of response system constructed from Atari keypads, which included an additional communication circuit board and LED display connected to the teacher's device by a special-purpose digital multiplexer (Russell & Pitt, 2004). This technology was not used for learning or teaching, but its use was tested in lectures at Christopher Newport University to increase interaction and learning (Abrahamson, 2006). This technology was criticised because of the lack of anonymity of responses and students who answered without critical thinking (Agbatogun, 2013).

The criticisms of ClassTalk led to creation of a the second generation, Classtalk2, which consisted of a Macintosh computer for the teacher, HP palmtop computers for students and a network connecting system (Russell & Pitt, 2004). This technology was used at Harvard University in a large lecture hall containing 500 seats, at the University of Massachusetts, Ohio State University and at Christopher Newport University

(Abrahamson, 2006). After a few years there were many criticisms that the system wasted lecturers' time because it required a lot of time to prepare for the lesson. Furthermore, the number of students who could use this technology was limited. Based on these criticisms, researchers developed the calculator-based system. In late 1996, it became problematic for Abrahamson to further fund the project; hence the project was transferred to Texas Instruments (TI). The new sponsor for the project showed little interest in the production of response systems because of the unsuccessful implementation of the previous generations of technologies (Abrahamson, 2006).

A new version of PRS was manufactured after cooperation between Professor Nelson Cue, the Hong Kong government, an electronics manufacturer in Hong Kong and an anonymous alumnus of Harvard University. This cooperation successfully developed an infrared wireless technology called EduCue's Personal Response System (PRS) (Agbatogun, 2013). This technology used infrared technology to provide feedback and keypads where students could be identified easily, regardless of the distance between the receiver and the keypad (Russell & Pitt, 2004). The current PRS is similar to EduCue's PRS and is considered either a new generation or the older technology with more advanced specifications (Abrahamson, 2006).

The components of PRS

Handset or keypad

The handset or keypad comes in pocket size or credit card size and is normally similar to a TV remote control (Agbatogun, 2013). There are many types of handset; some come with binary buttons, which are used to indicate true/false, yes/no, binary responses to questions. Other handsets come with many buttons with either alphabetical or numerical markings (Figure1).

Figure 30. Handset for PRS

Students' respond to the instructor's questions in the PRS activity by using the handsets. The configurations of some types of PRS handsets allow students to rate their confidence about the accuracy of their answers, as high, medium or low (Agbatogun, 2013). This feature allows instructors to determine whether students guess their answers or whether they know them. The handset can be used by students anonymously or the student can be identified. There are many options for anonymity. The first option is where the answers are not identified by instructor or students; the second option is when the answer is identified by the instructor through a code or student ID number assigned to each handset; and the third option is where the answers are identified by both the instructor and the students (Simpson & Oliver, 2007). King Khalid University has a Radio Frequency (RF) version of PRS, which is used anonymously, and is the one examined in this study. This type of PRS is wireless and operates more quickly than the other type of PRS. This system was employed in order to increase interactivity in lectures, promote peer discussion and allow students to answer their lecturer's questions anonymously without the potential embarrassment of making mistakes by choosing the wrong answers.

Receiver

The receiver is a USB stick attached to the instructor's device (Eastman, 2007). This is vital to the success of the PRS activity; any fault in it will inhibit the running of the activity. It makes a connection between the instructor's device and a large number of participant devices.

Software

Every company designs different software for their PRS. The majority of PRS software needs to be installed in the instructor's device prior to the lecture to allow responses to be received from students and questions from the instructor (Agbatogun, 2013). The interface for the software shows the number of questions to be asked in one lecture, the time allotted for the students to answer the questions (if needed), and maybe the number of attempts students have to select the correct answer. Additionally, the questions are incorporated into a PowerPoint presentation (as the majority of the software is compatible with Microsoft PowerPoint) in the order the instructor has designated. The timer (if used) starts to count down as soon as the instructor reaches the question slide, or can be activated at any point if the instructor generates the questions during the teaching time. The instructor can select the start time and the end time to answer the question. The questions are normally generated before the lecture, however most of the software types allow the lecturer to write questions during the lecture. The software shows the number of participants with a unique number or code for each student linked to a keypad.

The timer is optional for the lecturer and if they use it they can reduce or increase the allotted time to suit the difficulty of the question (Simpson & Oliver, 2007). The allotted time is usually between 15 seconds and 2 minutes to allow students to think and send their responses. After this time has elapsed the instructor can save the aggregated results

on the laptop and project these to the screen as feedback, or for future use (Simpson & Oliver, 2007)